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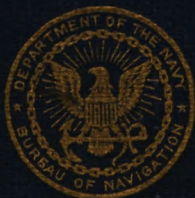
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THE
SHIP AND GUN DRILLS
UNITED STATES NAVY
1914

KC 1690

HARVARD UNIVERSITY



STUDENTS' ASTRONOMICAL
LABORATORY

H. J. Green

SH

THE
SHIP AND GUN DRILLS
U. S. NAVY
1914



UNITED STATES NAVAL INSTITUTE
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1916

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NAVY DEPARTMENT,
Washington, D. C.
30 September, 1914.

1. THE SHIP AND GUN DRILLS, U. S. NAVY, 1914, is approved and issued to the service, and supersedes all previous editions.

2. Attention is called to the addition of new *calls* in PART IX, BUGLE CALLS, rendered necessary by modern conditions, and to the shortening of some of the most commonly used *boat calls*.

3. The instructions contained herein shall be strictly followed.

JOSEPHUS DANIELS,
Secretary of the Navy.

CONTENTS.

Index	Page 5
PART I.—Organization	Page 17
PART II.—Battle Drills.....	Page 25
PART III.—Emergency Drills.....	Page 39
PART IV.—Gun Drills.....	Page 53
PART V.—Ordnance, Ammunition and Explosives...	Page 81
PART VI.—Ship Manuals.....	Page 169
PART VII.—Physical Exercises.....	Page 185
PART VIII.—Boatswain's Calls.....	Page 235
PART IX.—Bugle Calls.....	Page 249

INDEX.

ABANDON SHIP	Page	45
Bill, requirements of.....	Art.	338
Boats, capacities.....		341
return of.....		343
Calls		339
Provisioning for.....		342
Stations and duties.....		340
AMMUNITION, NOTES ON	Page	104
Ammunition, description	Art.	519
in general.....		518
Cartridge cases.....		524
Fuses		523
Primers		522
Projectiles		521
Tank and box markings.....		520
BAYONET EXERCISE	Page	194
Bayonet fighting.....	Art.	726
assault exercises.....		727, 728
Butt, use of.....		723
Combinations		725
Facings		720
Guard		718
change.....		724
Intervals, take.....		717
Parries		721
Steps		719
Thrusts		722
BOATSWAIN'S CALL	Page	235
Description of the call.....	Art.	801
Positions of the hand.....		803
Tuning the call.....		802
BOATSWAIN'S PIPE AND PASSING THE WORD	Page	238
Pipes and their uses.....	Art.	806
Score, explanation of.....		804
Voice, use of in passing the word.....		805
BROADSIDE GUN DRILLS	Page	70
Drill-s, general	Art.	450
7-inch/45		451
6-inch/50		452
5-inch/51		453
5-inch/50		454
4-inch/50		455
3-inch/50 S-A.....		456

BUGLE CALLS IN GENERAL	Page	249
Boat calls (list).....	Art.	904
Drill signals (explanation).....		907
General remarks.....		901
Infantry and artillery calls (list).....		905
Marches and quicksteps (list).....		908
Miscellaneous calls (list).....		903
Routine calls (list).....		902
Use of calls on shore, remarks.....		906
BUGLE CALLS USED ON BOARD SHIP	Page	260
Boat calls (scores).....	Art.	911
Miscellaneous calls (scores).....		910
Routine calls (scores).....		909
CLEAR SHIP	Page	25
General instructions.....	Arts.	201-203
Preparedness	Art.	201
Thoroughness		202
Two stages in.....		203
CLEAR SHIP FOR ACTION	Page	26
Call for.....	Art.	208
General duties.....		209
COLLISION	Page	41
Anchor, at.....	Art.	321
Calls		322
Duties, general		324
detailed		325
Escapes in.....		326
General quarters, at.....		327
Officers, stations at.....		323
COMPLEMENT	Page	17
Crew	Art.	102
Officers		101
Subdivisions of.....		103
DEMOLITIONS	Page	157
Army methods.....	Art.	563
Demolition work.....		561
Hasty demolitions.....		562
Trinitrotoluol, by.....		564
DEPARTMENTS AND DIVISIONS	Page	18
DEPARTMENT		
Construction	Art.	116
Engineering		112
Gunnery		104
Medical		118
Navigation		110
Pay		120

DIVISION-S	
Auxiliaries	Art. 115
Boilers	114
Fire control.....	108
Gun	105
intermediate	107
secondary	107
turret	106
Main engines.....	113
Navigator's	111
Numbering of.....	122
Paymaster's	121
Repair	117
Surgeon's	119
Torpedo	109
EMERGENCY (IN GENERAL)	Page 39
Casualties to personnel, in.....	Art. 313
Communications in.....	309
Details	307
Drills, definition of.....	301
Hammocks, clear.....	312
Officer-s, of the deck in.....	303
arms	304
calling at night.....	308
Pilot ladders, etc., in.....	314
Retreat from.....	311
Secure from.....	310
Signal	302
Silence in.....	305
Stations	306
FIRE	Page 42
Breathing apparatus, in.....	Art. 336
Calls	329
Compartments, care, against.....	334
Details, special.....	331
Duties, general.....	332
officers	330
Equipment, testing.....	333
Extinguishers	335
General quarters, at.....	337
Instructions, general.....	328
FIRE AND RESCUE	Page 48
Calls	Art. 345
Employment	344
Fire detail.....	348
Gun-cotton detail.....	350
Organization	346

FIRE AND RESCUE.—(Con.).....	Page	48
Relief detail.....		349
Rescue detail.....		347
GENERAL MUSTER.....	Page	172
Ceremony	Art.	612
Formation		611
GENERAL QUARTERS.....	Page	33
Arms	Art.	237
Call		230
Collision at.....		327
Definition		228
Exercise		232
Fire at.....		337
General duties.....		229
Reports		232
GUARD OF THE DAY, THE.....	Page	173
Details and tours.....	Art.	618
Guard, chief petty officer of the.....	614,	622
commander of the.....		621
men of the.....		625
officer of the.....		613
petty officers of the.....		623
general duties.....		624
strength of the.....		616
uniform and arms of the.....		620
Lower deck petty officers.....		615
Orders		626
Posts of sentinels.....		619
Rosters		617
GUARD MOUNTING.....	Page	179
Accountments	Art.	629
Call		630
Formation		631
Instructions, general		633
detailed		634
Relief, to post and dismiss.....		632
Weather, in fair.....		627
in foul.....		628
GUN COTTON.....	Page	147
Care and handling.....	Art.	554
Detonators		559
Drying		553
Gun cotton.....		551
Inspections		555
Manufacture, specifications.....		552
Mines and countermines.....		557
Primers		558
War heads.....		556

GUN DRILLS, GENERAL NOTES	Page	53
Casualties, matériel	Art.	409
personnel		410
Commands, manner of giving.....		404
used		405
Division officer's responsibility.....		408
Exercise, preparing for.....		406
providing for, details.....		407
Gun stations, assignment		402
muster, falling in for.....		403
Instructors		401
INFANTRY AND ARTILLERY CALLS	Page	275
Calls used mainly on shore (scores).....	Art.	912
Drill signals (scores).....		913
LOADING, NOTES ON	Page	62
Accuracy	Art.	428
Carelessness in.....		432
Drill, amount of.....		431
development of.....		430
General rules.....		433
Movement required.....		429
Rapidity		427
MARCHES AND QUICKSTEPS	Page	283
Marches (scores).....	Art.	914
Quicksteps (scores).....		915
MIS-FIRES AND HANG-FIRES	Page	58
Classification of guns, for.....	Art.	419
Hang-fire, charge, causes.....		418
definition		416
Mis-fire-s, calling		425
charge, causes.....		418
classification		415
definition		414
primer, causes.....		417
Priming tools, use of.....		424
Procedure		420
B.L.R. guns TAB. I.....		421
comb. pri. cart. case guns TAB. II.....		422
perc. pri. cart. case guns TAB. III.....		423
war-time		426
ORDNANCE OUTFIT, CARE AND PRESERVATION	Page	81
Accessories and spare parts.....	Art.	507
Cleaning and routine.....		501
Elevating and training gear, lost motion.....		513
Farcot breech mechanism.....		505
Gas checks.....		504

ORDNANCE OUTFIT, CARE AND PRESERVATION.—(Con.)	Page	81
Loading and unloading	Art.	503
Miscellaneous instructions		506
Pressure gauges		516
Proof of guns		517
Recoil cylinders, construction, faults and remedies		512
filling		510
liquid and care		509
piston rod packing		511
Saluting instructions		508
Sights, broadside mounts		514
care and adjustment		515
Turrets		502
PHYSICAL DRILL WITH ARMS	Page	203
Coming to ready	Art.	730
Diagonal lunges		735
Down and forward		731
Forward and up		732
Forward lunges		736
Front sweeps		737
General rules		729
Overhead twists		738
Side pushes		734
Side twists		739
Up and shoulders		733
PHYSICAL DRILL WITHOUT ARMS	Page	210
Elementary exercises	Art.	740
General service exercises		741
POWDER, NAVY SMOKELESS	Page	112
Blending and packing	Art.	534
Care in storage		536
Dehydration		529
Drying		533
Grains, pressing and cutting		532
Manufacture		525
Materials, prime, preparation		526
Mixing		530
Nitration		527
Proof of, and assignment of charges		535
Purification		528
Straining		531
POWDER, PRESERVATION AND TESTS	Page	122
Care, handling and storage	Art.	537
Decomposition of		540
Oven, constant temperature		539
Tests and inspections		538

QUARTER BILL	Page	28
Action, and standing by for.....	Arts.	219-225
Aid to wounded.....	Art.	217
Armament and ammunition.....		213
Battle, organization.....		211
preparations for.....		227
stations		210
training at.....		218
Fire control.....		212
Maintenance and routine.....		226
Motive machinery.....		215
Repairs		216
Ship control.....		214
QUARTERS FOR MUSTER AND INSPECTION	Page	169
Calls	Art.	601
Department formation.....		604
Division-s, parades		602
small, formation of.....		608
succession in the.....		607
to form the.....		606
Formation after secure.....		609
Inspections		610
Officers, duties of.....		603
and petty officers, posts of.....		605
SIGHT-SETTING NOTES	Page	57
Accuracy, necessity for.....	Art.	411
Sight-setter, selection of.....		412
training of.....		413
STATION BILLS	Page	22
General provisions of.....	Art.	123
STRIP SHIP	Page	25
Material to be landed.....	Art.	205
Protective preparations.....		206
Torpedoes		207
When done.....		204
SWORD EXERCISE	Page	185
Assault	Art.	715
Attacks, comp., and returns.....		708
single, examples.....		712
comp., examples.....		714
single		706
examples		710
and returns, single, examples.....		711
comp., examples.....		713
Dismiss		716
Engagement		709

SWORD EXERCISE.—(Con.)	Page	185
General remarks.....	Art.	701
Guards		703
Moulinets		702
Parries		705
Returns		707
Steps		704
TORPEDO DEFENSE QUARTERS	Page	35
Arms	Art.	237
Calls		235
Definition		233
General duties.....		234
Reports		236
TORPEDOES, CARE AND HANDLING	Page	133
Adjustments, tests.....	Art.	543
Care, on board ship.....		542
Faults and remedies.....		548
Gyros, notes on.....		550
Miscellaneous		549
Recovery after firing.....		546
Repairs on board ship.....		547
Run, exercise, preparation.....		544
War, in time of.....		541
shot, preparation.....		545
TRINITROTOLUOL		560
Demolition by.....		564
TURRET GUN DRILLS	Page	65
Detailed drill.....	Art.	434
Loading-s, exercises		443
position		439
preliminary instruction.....		442
timing		444
Pointers, selection of.....		448
training of.....		447
Powder passing.....		446
Priming		445
Safety		449
Turret, control of.....		435
drill commands.....		438
gun-crew titles, standard.....		440
living in.....		437
stations		436
assignment to.....		441

WATERTIGHT INTEGRITY.....	Page	40
General rule.....	Art.	315
Organization for.....		316
W. T. doors, call.....		317
closing		318
duties		319
remarks		320

PART I

ORGANIZATION

	PAGE
COMPLEMENT	17
DEPARTMENTS AND DIVISIONS.....	18
STATION BILLS.....	22

ORGANIZATION.

COMPLEMENT.

101. Officers.—

(1) The following will be the complement of a ship:

- (a) The captain,
- (b) The executive officer,
- (c) The gunnery officer,
- (d) The navigating officer,
- (e) The engineer officer,
- (f) The first lieutenant,
- (g) The medical officer,
- (h) The pay officer,

and a sufficient number of officers of the line and staff corps junior in their own corps to the above to officer effectively the ship for battle, and to keep the matériel and personnel in such condition as to be prepared for battle.

(2) When the size of the ship, or the number of officers available, is not sufficient to provide the number of senior officers given above, the duties and responsibilities of two or more of them will be combined in accordance with the provisions of the Navy Regulations.

(3) When marines are added to or included in the complement of a ship, a sufficient number of marine officers to officer the marines division will be required.

102. Crew.—The complement to be based upon the number of men required in battle and in keeping the matériel and personnel in such condition as to be prepared for battle, namely:

- (a) A fully manned ship control,
- (b) A fully manned fire control,
- (c) A full crew for each gun of the heavy and intermediate batteries and for each torpedo tube,
- (d) A pointer group and a reduced crew for each secondary gun,
- (e) Men sufficient to provide for a supply of ammunition during a protracted engagement,
- (f) Men sufficient for an engineer's force to maintain full speed in two watches for a protracted battle,
- (g) A sufficient force to provide for exterior and interior communication,
- (h) A sufficient force for the operation of the electric installation, including searchlights,
- (i) Men sufficient to provide repair crews,
- (j) Men sufficient for the surgeon's division,

(k) The special ratings required to mess and supply officers and men under service conditions; to be utilized in filling battle stations.

103. Subdivisions of the complement.—The complement of officers and men shall be organized into such divisions and crews as will be most conducive to the fighting efficiency of the ship; and upon this organization will be based all station bills for routine work. Fighting units, crews and divisions will be so assigned to ship's work as to be kept together and as near as possible to their battle stations. So far as practicable, the divisions and crews performing routine work will be commanded and directed in such work by the officers and petty officers who will control them in battle. For convenience of administration, divisions will be grouped under the appropriate department heads.

DEPARTMENTS AND DIVISIONS.

104. Gunnery department.—

I. The gun divisions (including marines division, and, on small ships, when desirable, a powder division).

II. The fire control division.

III. The torpedo division.

I.

105. Gun divisions.—(A) Turret gun divisions.

(B) Intermediate gun divisions.

(C) Secondary gun divisions.

(1) Definitions of guns.—

(a) *Turret guns* are guns mounted in turrets.

(b) *Intermediate guns* are 7-inch, 6-inch, 5-inch and 4-inch guns.

(c) *Secondary guns* are 3-inch, 6-pounder and 3-pounder guns.

(2) Definitions of batteries.—

(a) *The main battery* includes those guns that would primarily come into action in a day battle. In heavy ships carrying a battery of intermediate guns, this battery would, at close range under certain circumstances, be brought into action with the main battery. In light ships, whose main batteries are intermediate guns, such guns would be in action in day as well as night battle, and in such light ships the intermediate guns would constitute the main battery. In small gunboats, auxiliaries and destroyers, armed with secondary guns only, such guns would constitute the main battery.

(b) *The torpedo defense battery* includes those guns that would be grouped in action primarily against torpedo craft day

or night. In both heavy ships and light ships, it comprises the intermediate and secondary guns. In light ships, auxiliaries and destroyers it is identical with the main battery.

(A).

106. Turret gun divisions.—Each 14-inch, 13-inch, 12-inch and 10-inch turret; each superposed turret; each 8-inch turret on the center line; each pair of waist turrets (a turret and its opposite) will constitute a division.

(1) *Turret gun crews.*—

(a) Three-gun turret crews.—Each right gun crew and one-third of the handling room crew, one-half of the mid-gun crew and one-sixth of the handling room crew will be stationed in the starboard watch; each left gun crew and one-third of the handling room crew, one-half of the mid-gun crew and one-sixth of the handling room crew will be stationed in the port watch.

(b) Two-gun turret crews.—Each right gun crew and one-half of the handling room crew will be stationed in the starboard watch; each left gun crew and one-half of the handling room crew will be stationed in the port watch.

(c) Superposed turret crews.—Both right gun crews and one-half of the handling room crews will be stationed in the starboard watch; both left gun crews and one-half of the handling room crews will be stationed in the port watch.

(2) *Numbering turret divisions.*—Turret divisions are to be numbered in sequence from forward aft.

(3) *Numbering turrets.*—Center line turrets mounting the same caliber, and superposed turrets mounting two calibers, will be numbered serially from forward aft. Waist turrets will be numbered serially from forward aft; starboard turrets odd numbers, port turrets even numbers.

(4) *Numbering turret guns.*—Guns of the same caliber in turrets on the center line will be numbered serially from forward aft; right guns the lowest number in the turret. Each caliber in superposed turrets will have its own series. Guns of waist turrets will be numbered serially; for example, starboard forward turret, right gun, "8-inch No. 1"; left gun, "8-inch No. 2"; port forward turret, right gun, "8-inch No. 3"; left gun, "8-inch No. 4"; and so on.

(B) and (C).

107. Intermediate and secondary gun divisions.—As the mounting of guns for torpedo defense will vary according to the structural features of different ships, no hard and fast rule can be laid down for the assignment of intermediate and secondary

guns to divisions. In general, a torpedo defense group should control guns of only one division.

(1) *Intermediate and secondary gun crews.*—One-half the crew of every intermediate and secondary gun shall be in the starboard watch, one-half in the port watch; in such a manner that, in torpedo defense watches, each watch will be capable of instantly beginning a torpedo defense action.

(2) *Numbering intermediate and secondary gun divisions.*—These will be numbered in sequence from forward aft, following the turret divisions, each in its own class.

(3) *Numbering intermediate and secondary guns.*—The starboard guns will have odd numbers; port guns, even numbers; lowest numbers forward. If the forwardmost gun is on the center line, that gun will be No. 1 of its class. These guns will have a separate series for each caliber, and, where practicable, will be so numbered that each torpedo defense group controls consecutive numbers, odd, even, or both, as the case may be.

II.

108. *Fire control division.*—The fire control division shall comprise those officers and men detailed to fire control stations. Men of other divisions, assigned for battle stations only, shall for routine administration duties be included in and muster with their respective divisions.

III.

109. *Torpedo division.*—The torpedo division comprises:

(1) *The torpedo crews* and men stationed to direct and control the torpedo fire.

(2) *The gunner's crew*, in charge of the gunner, comprising such men as may be detailed by the captain for the care, upkeep and repair of ordnance material. The gunner performs these duties under the direct supervision of the gunnery officer.

(3) Torpedo tubes shall be numbered serially from forward aft, starboard tubes odd numbers, port tubes even numbers.

110. *Navigation department.*—

IV. The navigator's division.

IV.

111. *Navigator's division.*—

(1) *The ship control crew.*

(2) *The signal crew.*

(3) *The radio crew.*

112. Engineering department.—

V. The main engines division.

VI. The boilers division.

VII. The auxiliaries division.

V.

113. Main engines division.—Comprises those men having to do with the operation and maintenance of the main engines.

VI.

114. Boilers division.—Comprises those men having to do with the operation and maintenance of the boilers.

VII.

115. Auxiliaries Division.—Comprises those men having to do with the operation and maintenance of the auxiliaries.

116. Construction department.—

VIII. The repair division.

VIII.

117. Repair division.—

(1) *The boatswain's crew*, comprising the nucleus of the deck repair crew.

(2) *The carpenter's crew*, comprising the hull repair crews.

118. Medical department.—

IX. The surgeon's division.

IX.

119. Surgeon's division.—*The hospital corps force.* Men of other divisions, assigned for battle stations only, shall for routine administration duties be included in and muster with their respective divisions.

120. Pay department.—

X. The paymaster's division.

X.

121. Paymaster's division.—

(1) *Pay and G. S. K. crew* comprises those men detailed for duty therein.

(2) *Commissary crew* comprises all men having to do with the commissary of the ship and including officers' messmen.

122. Numbering divisions.—Divisions shall be numbered in the following order:

- I. (A) Turret gun divisions.
- I. (B) Intermediate gun divisions.
- I. (C) Secondary gun divisions.
- II. Fire control division.
- III. Torpedo division.
- (Powder division.)
- IV. Navigator's division.
- V. Main engines division.
- VI. Boilers division.
- VII. Auxiliaries division.
- VIII. Repair division.
- IX. Surgeon's division.
- X. Paymaster's division.

STATION BILLS.

123. General provisions.—Every ship shall have comprehensive *watch*, *quarter* and *station bills* showing the stations and duties of officers and men at clear ship, standing by for action and action—day and night, collision, fire, boats, landing force, cruising, fueling, cleaning and care of ship, and liberty. The *quarter bill* is the basis of ship organization and all other bills shall be derived from it. In its scope the *quarter bill* will embody the whole ship, and in its detail it will provide for every contingency of battle that can reasonably be foreseen.

PART II

BATTLE DRILLS

	PAGE
CLEAR SHIP.....	25
QUARTER BILL.....	28
GENERAL QUARTERS.....	33
TORPEDO DEFENSE QUARTERS.....	35

BATTLE DRILLS.

CLEAR SHIP.

GENERAL.

201. Preparedness.—It is the duty of the ship to take the initiative in maintaining a full allowance of fuel, ammunition, stores and spare parts. It may become impossible to overcome defects and supply deficiencies when hostilities are impending. A ship, on leaving port, should at all times be prepared for action on short notice. Guns should be kept bore sighted. The stripping and clearing of the ship should mean only the accomplishment of details contributing to the offensive use of the armament and to the protection of personnel and matériel.

202. Thoroughness.—*Clear ship* is to be considered as an *evolution* in which *thoroughness* is the first consideration.

203. Two stages of clear ship.—Ships shall be cleared for battle as far as matériel is concerned in *two stages* under the following designations:

- I. *Strip ship.*
- II. *Clear ship for action.*

I. STRIP SHIP.

204. When done.—This shall be done when war is impending.

205. Material to be landed.—(*For drill and inspection the following material shall be tagged "Store." Boats may be anchored off*):

- (1) Boats; except those designated by the commander-in-chief.
- (2) Bunks and mattresses (except sick bay mattresses) which cannot be quickly disposed of at *Clear Ship for Action*, and wooden furniture, chests, doors and lockers.
- (3) Generally everything, inflammable or liable to cause splinters, that can be dispensed with.
- (4) Jackstaff, flagstaff and boat booms (at discretion).
- (5) Stanchions and davits not needed. (Facilities for spreading certain awnings should be retained.)
- (6) Unnecessary canopy frames.
- (7) Accommodation ladders.
- (8) Unnecessary clothing of officers and men.
- (9) Substitute windsails for ventilators where possible.
- (10) Mess tables and benches. (These may be retained until probable contact with the enemy.) (Prepare mess cloths.)

206. Protective preparations.—(*Need not be done for drill and inspection*):

(11) Rig wire splinter nets under engine room and fire room gratings.

(12) Rig splinter screens and mantlets.

207. Torpedoes.—(*Need not be done for drill and inspection*):

(13) Fit war heads.

II. CLEAR SHIP FOR ACTION.

208. The call.—The boatswain's pipe "All hands clear ship for action."

209. General duties.—(*For drill and inspection the following details need not be completed, but the ship's bill shall show in detail what should be done*):

(1) Prepare for full power.

(2) Serve out lunches. Haul galley fires.

(3) Stow in torpedo rooms detonators and dry primers for use in torpedoes. Others shall be stowed in safe compartments well below the water line.

(4) Prepare to load torpedoes.

(5) Release prisoners.

(6) Throw overboard unnecessary inflammable oils, paints and liquids.

(*For drill and inspection the following shall be done*):

(7) Rig light life lines which, if carried away, will not foul screws. Lay down and secure davits and stanchions. (The necessary short stanchions should be so fitted on rails and bridges that they can be kept shipped and not interfere with gun fire.)

(8) Fill recoil cylinders.

(9) Prepare dynamos, air compressors and fire and bilge pumps for service, and start those necessary.

(10) Connect up and test out all fire control and ship control communications and instruments.

(11) Test out and prepare for action all firing circuits and air blasts.

(12) Connect up and lead out fire hose. (Secure hose so as to be clear of blast of guns.)

(13) Rig all necessary blast screens. Secure searchlights against blast.

(14) Throw in battle circuits. Throw out all circuits not required for action.

(15) Prepare auxiliary lighting arrangements.

(16) Rig battle signal stations (radio and flag).

(17) Rig repair stations; prepare collision mat.

(18) Rig dressing stations and prepare transportation for wounded.

- (19) Supply first aid packages.
- (20) Fill gun tubs.
- (21) Supply drinking water.
- (22) See in proper places necessary spare parts. Supply ray filters and material for wiping off sights.
- (23) Prepare auxiliary steering and ship handling stations.
- (24) Shut steam not needed off all unprotected leads. Prepare to operate boiler stop and safety valves from outside boiler compartments.
- (25) Wet down weather decks and plug scuppers. Put water in boats and lash canvas about them.
- (26) See auxiliary gear for sustaining combat ready for use. Appliances for group or independent control of guns at hand. Ammunition supply and transportation gear rigged.
- (27) Rig torpedo firing director and test torpedo firing circuit and special signals and lines of communication to torpedo room.
- (28) Provide grapnels for clearing the screws.
- (29) Secure anchors, unbend chains and pay below. (While on soundings keep one chain bent.)
- (30) Stow life preservers in convenient but protected places.
- (31) Close the watertight doors and hatches designated to be sealed during action. Close battle ports. At night screen lights. (Attention is called to the necessity for not interrupting the means of access or of communication to the various parts of the ship.)
- (32) Unship and secure the ventilators and ladders that interfere with the battery.
- (33) Stowage shall be assigned to the following, which will leave free passage for the ship's company and protection from gun fire:
 - (a) Navigational instruments.
 - (b) Coaling gear.
 - (c) Mess and galley gear.
 - (d) Sick bay mattresses not needed, bags, hammocks, ditty boxes and cots.
 - (e) Gunnery training gear.
 - (f) Diving gear.
 - (g) Field guns.
 - (h) Wash deck gear.
 - (i) All other loose gear.
- (34) Before battle men shall bathe and shift into clean underclothes.
- (35) Supply ammunition (see Articles 220, 222 and 224).
- (36) Have small arms and ammunition ready for serving out.
- (37) Masthead the battle ensigns and make all final preparations for battle.

QUARTER BILL.

210. Battle stations and reliefs.—

- (1) Captain, conning tower; relief, executive.
- (2) Executive, secondary ship control station; in direct communication with the captain.
- (3) Gunnery officer, chief fire control (Groups I and II); relief, first lieutenant.
- (4) Navigating officer, primary ship control station (Group III); relief, designated by the captain.
- (5) Engineer officer, engine rooms (Group IV); relief, next in rank in the engineering department.
- (6) First lieutenant, central station (Group V); relief, designated by the captain.
- (7) Medical officer, primary dressing station (Group VI); relief, next in rank in the medical department.
- (8) Pay officer, station and relief to be designated by the captain.

211. Battle organization.—The quarter bill shall show the grouping of officers and men with their stations and duties in the battle organization as follows:

I.

212. Fire control.—

- (1) Determination of the initial range during the "approach."
- (2) Under all conditions of battle:
 - (a) Successive stations.
 - (b) Direction and control on one target.
 - (c) Division and control on two targets on the same side.
 - (d) Division and control on two targets on opposite sides.
 - (e) Direction and control of torpedo defense battery on attacking destroyers during a day action.
 - (f) Independent turret control.
 - (g) On attacking destroyers at night.
- (3) Casualties and procedure.
- (4) Secondary searchlight locations.

II.

213. Armament and ammunition.—

- (1) Guns and torpedoes.
- (2) Ammunition supply.
- (3) Gun crews in reserve.
- (4) Gun and torpedo casualties.
- (5) Ordnance repair crew.

III.

214. Ship control.—

- (1) Battle signalling.
- (2) Successive ship control stations.
- (3) Successive steering stations, methods of steering.
- (4) Interior communication.

IV.

215. Motive machinery and auxiliaries.—

- (1) Engines, boilers and auxiliaries.
- (2) Casualties and procedure.
- (3) Engineer force in reserve.
- (4) Engineer repair crew.

V.

216. Repairs.—

- (1) Fire and collision in action.
- (2) Watertight doors closed and those not to be closed.
- (3) Procedure in emergencies, such as fouling screws; masts, one or both, shot away; taking disabled ship in tow, etc.
- (4) The repair crews will be available for fighting fires, operating valves, shoring bulkheads, stopping leaks, clearing wreckage, repairing electric leads, etc. Portables and tools will be supplied at the repair stations. Tools shall include wrenches, sledges, clamps, crowbars, tackles, shores, pipe cutters, gear for repairing electric leads and apparatus, etc. Stowage at the repair stations should be provided for this gear. The repair crews shall include the rescue breathing apparatus details.

VI.

217. Aid to wounded.—

- (1) Primary and secondary dressing stations.
- (2) Stretcher men details.
- (3) General instructions.*
 - (a) First aid appliances include shell wound dressings and tourniquets. Solutions for the smoke-inflamed eyes of the men at the guns, and dressings for burns and scalds in engine and fire rooms, plainly labeled, should be accessible to those stations.
 - (b) First aid instruction comprises the following:
 - (1) Continuous first aid service to the wounded during battle on the part of the personnel at large. The effectiveness of this service will depend largely upon the thoroughness with which

* Prepared in the Bureau of M. and S.

the units have been previously instructed by the medical and division officers, as required under the Regulations; and how well they have become imbued with the principle that first aid, calmly administered to themselves or by their comrades, represents the maximum service that can be rendered the wounded during the height of a naval action. The ship's force should have been warned that elaborate measures of treatment or extensive transportation during battle are both inadvisable and impracticable. The wounded man, after the administration of first aid, should be placed to one side, where his presence will be least felt and where he will not incommode or disturb the fighting force.

(2) In a suspension or lull of battle when prompt treatment of the wounded at or near the battle stations is impossible, the stretchermen shall be required to seek out the wounded, to afford them relief, to transport them to the battle dressing stations and to prepare a list of the killed. It should be the first duty of the medical officer to give attention to those whose services can be restored. These men should be promptly returned to their stations. It must be borne in mind that the primary purpose of first aid is to keep as many effectives at their stations as possible. A graver class of injuries may require deliberate surgical intervention, but extensive procedures on the part of the ship's force are only legitimate if removal of the wounded from the ship is delayed. To assure the wounded early and efficient treatment, effect their rapid removal from the fighting ship and insure a continuous record of each case is the object of the organization.

(c) (1) Routes to dressing stations should be indicated by an arrow and a red cross. There should be at least two dressing stations, a primary station and a secondary station. These stations should have an abundant supply of drinking water, all connections being behind armor. Storage tanks for drinking water should be provided, having a capacity sufficient to furnish, in first-class ships, one gallon of water per man, allowing for twenty per cent of wounded. Dressing stations should also be well ventilated, well lighted and as cool as the surroundings will permit. It has been estimated that for each thirty-six square feet of area, one cargo light of approximately two hundred candle power (six lamps) should be provided. Lanterns and electric bull's-eyes should be available in case the battle circuits suffer interruption. Electric or steam connections should be provided for the sterilizers. Sterilizers should be removed from the surgical operating room, and set up in the primary dressing station prior to action. There should be some provision made for the drainage of this space. In the vicinity of the dressing station or adjoining it, there should be arranged a berthing space for the wounded, sufficient to accommodate about ten per cent of the complement. This space should be easy of access from the dressing station,

and, like the latter, have an abundant air supply. In addition to the usual equipment transferred from the sick bay and operating room and distributed in the dressing stations, the following articles should be provided: Electric fans with proper connections, half tubs, water buckets, swabs and brooms, washing stands, tables for apparatus, shelves, supports or hooks for irrigators, etc., battle dressing lockers, bedding for the berthing space of the wounded, restoratives, etc. A reserve supply of surgical dressings should be available on this deck in a secondary station behind armor and accessible for distribution to the dressing stations.

(2) The station of the medical officer of the ship during battle shall be, as a rule, at the primary (operating) dressing station, where he shall see that the necessary equipment for operations and dressings is provided.

(d) Means of identification of the killed as required by Article XVII of the Tenth Hague Convention should be provided for each officer and man.

(e) The organization of the medical department, showing all dispositions under battle conditions, shall be worked out for the ship on going into commission. Provision shall be made for instruction of officers and men in first aid; for the equipment and organization of battle dressing stations as described above; and for a definite organization of the personnel of these stations, as well as for their progressive instruction in the methods of first aid and transportation.

(f) The galley and bakery in ships of old type, if intact, after an engagement should be placed at the disposition of the medical officer for preparing additional hot water and dressings and for sterilizing instruments.

(g) Apparatus for transporting the wounded will be provided by the medical department of the ship. Simple measures designed to facilitate transporting the wounded by stretcher into boats or directly to the dressing stations by the most convenient hatch, down which they will be lowered or passed by hand to the deck below, are to be preferred to more elaborate means.

(h) A fighting ship should be cleared of wounded as soon as possible.

218. Training at battle stations.—The battle exercises are not to be regarded as periods of training so much as tests of the training. The above groups shall receive their battle training independently (see **Bugle Calls, Part IX**). Provision must be made for fully manning secondary battle stations for ship control and fire control, and for exercising control from those stations.

219. Standing by for action, and action.—The quarter bill must give the watches and dispositions for:

Standing by for action, and action,

- (1) Daylight,
 - (a) Weather clear.
 - (b) Weather thick.
 - (c) Submarine or torpedo boat attack.
- (2) Night.

220. Standing by for action, (1) daylight, (a) weather clear.

—If the action is not imminent, routine watches may be kept. Special lookouts shall be stationed. Ammunition not to be supplied until the call *general quarters*.

221. Action, (1) daylight, (a) weather clear.—*General quarters*. The intermediate guns will be manned or the crews held in reserve depending on the range. Secondary gun crews held in reserve. Provision shall always be made to repel a torpedo boat attack while the main battery is engaged.

222. Standing by for action, (1) daylight, (b) weather thick, or (c) submarine or torpedo boat attack.—The following dispositions are required:

(1) Officers and crew, except engineer's force, in two watches on the following stations:

- (a) Ship control.
- (b) Fire control.
- (c) All guns and ammunition.
- (d) Torpedoes and torpedo director.

(2) Ammunition:

(a) Turret guns loaded. (The charges between guns and magazines to depend on type of ammunition supply and safety regulations.)

(b) Intermediate guns, five rounds.

(c) Secondary guns, two boxes.

223. Action, (1) daylight, (b) weather thick, or (c) submarine or torpedo boat attack.—Either *general quarters* or *torpedo defense quarters*. If an attack by torpedo boats is probable, it would be advisable to keep the torpedo defense battery manned, as well as the main battery.

224. Standing by for action, (2) night.—It must not be assumed that, while the torpedo defense is, at this time, considered of primary importance, a night engagement with the main battery is an improbable contingency. The following dispositions are required:

(1) Officers and crew, except engineer's force, in two watches on following stations:

- (a) Ship control.
- (b) Fire control.
- (c) All guns and ammunition.
- (d) Torpedoes and torpedo director.
- (e) Searchlight control.

(2) Ammunition:

- (a) Turret guns, keep ammunition in magazines.
- (b) Intermediate guns, ten rounds; guns loaded at discretion.
- (c) Secondary guns, four boxes; guns loaded at discretion.

(3) Each group shall have assigned to it a searchlight and lookout arc. Each turret shall maintain lookouts stationed on the turret top.

(4) At sunset all dispositions completed, including screening of lights.

225. Action, (2) night.—Torpedo defense quarters. The watch below shall take battle stations. The main battery divisions must be trained to deliver an effective fire without such officers and men as may be detailed to the torpedo defense stations. The turret guns and torpedoes ordinarily will not be used to repel a torpedo boat attack, but occasion might arise when the main battery and the torpedoes would be used while engaged in torpedo defense; and therefore provision must be made for quickly passing from *torpedo defense* stations to *general quarters* stations.

226. Maintenance and routine.—Ships must be prepared for immediate action night or day for a long period during a war; and watches, details of duty and dispositions must be arranged accordingly.

227. Final preparations for battle.—These shall be made when battle is *imminent*, or when standing by in *thick weather*, or *before sunset*. In daylight, the call to *general quarters* is the signal for final preparations. Circumstances will govern in the case of certain final preparations such as hauling galley fires, starting dynamos, etc. At night the guns must be kept cleared and manned by the watch. The extent to which men off watch may turn in hammocks will depend on circumstances. The call to *torpedo defense quarters* is the call to the watch below to take stations.

GENERAL QUARTERS.

228. Definition.—*General quarters* calls the ship's company to stations primarily for manning the main battery, and secondarily for repelling a torpedo boat attack.

229. General duties.—

- (1) (a) Man battery and take battle stations.
- (b) Load torpedoes.
- (c) Connect fire hose.
- (d) Stand by manifolds and valves.
- (e) Stand by cut-out switches and switchboards.
- (f) Test out all gear.

(2) All those preparations and dispositions enumerated under *clear ship for action* which are necessary for the control and service of the battery shall be carried out to the extent necessary to use the battery.

(3) Every officer and man must occupy his battle station at general quarters. Fleet working parties, and ship's work and boating must give way to the general quarters routine.

230. The calls.—

(1) Day action signals:

(a) General alarm.

(b) *General quarters* on the bugle. (*Call No. 29.*)

(c) "General quarters" over interior communication system.

(2) Secure signals:

(a) *Secure* on the bugle.

(b) "Secure" over the interior communication system.

231. Reports.—

(1) "Ready." (To be made over fire control and interior communication systems.)

(a) Gun divisions, fire control division and torpedo division report to chief fire control.

(b) Ship control, radio and signal crews report to navigating officer.

(c) Engineering department, medical department and repair crews report to central station.

(d) Chief fire control, navigating officer and central station report to executive.

(e) Executive reports to captain.

(2) "Secure." (To be made in person.)

(a) After secure, divisions assemble at quarters. Senior present in each division report to head of department.

(b) Heads of departments report to executive.

(c) Executive reports to captain.

232. The exercise.—(1) Thorough preparation shall be made for every general quarters exercise, and a definite program shall be drawn up and followed at this drill, during which casualties shall be simulated.

(2) The training of units of the battle organization and gun crews should not be attempted at general quarters except to simulate casualties to personnel and matériel. Gun crews and other units are expected to be expert before the ship goes into action, and they should be brought to thorough proficiency before seriously taking up the problems of general quarters.

TORPEDO DEFENSE QUARTERS.

233. Definition.—*Torpedo defense quarters* calls the ship's company to stations primarily for repelling a torpedo boat attack, and secondarily for manning the main battery.

234. General duties.—

- (1) *Before sunset*,
 - (a) Man battery and take torpedo defense stations; man searchlights.
 - (b) Load torpedoes.
 - (c) Connect fire hose.
 - (d) Stand by manifolds and valves.
 - (e) Stand by cut-out switches and switchboards.
 - (f) Test out all gear and searchlights.
 - (g) Screen lights.
 - (h) Complete preparations necessary for the control and service of the battery.
 - (i) When all "ready" reports are in, "set the watch"; watch below disperse to designated parts of the ship close to their right battle stations.
- (2) *After sunset*, the ship should be standing by for action, night (**Article 224**); and as all duties should have been attended to before sunset, and as all stations should be occupied by the battle watch, it remains only for the watch below to take stations for torpedo defense.
- (3) *Every officer and man* must occupy his battle station at *torpedo defense quarters*.

235. The calls.—

- (1) Night action signals:
 - (a) General alarm.
 - (b) *Torpedo defense quarters* on the bugle (*Call No. 28.*)
 - (c) "Torpedo defense quarters" over interior communication system.
- (2) Secure signals:
 - (a) *Secure* on the bugle.
 - (b) "Secure" over interior communication system.

236. Reports.—

- (1) "Ready." (To be made over fire control and interior communication systems.)
 - (a) Gun groups and searchlights report to group control officers.
 - (b) Group control officers, turrets and torpedo division report to chief fire control.
 - (c) Ship control, radio and signal crews report to navigating officer.
 - (d) Engineering department, medical department and repair crews report to conning tower.

(e) Chief fire control, navigating officer and conning tower report to executive.

(f) Executive reports to captain.

(2) "Secure." (To be made in person.)

See *general quarters*, **Article 231** (2), which procedure follow.

237. Arms.—Both at general quarters and at torpedo defense quarters officers, turret captains and other petty officers so ordered will wear service pistol and, in time of war, or as ordered, will carry ammunition.

PART III

EMERGENCY DRILLS

	PAGE
EMERGENCIES IN GENERAL.....	39
WATERTIGHT INTEGRITY.....	40
COLLISION	41
FIRE	42
ABANDON SHIP.....	45
FIRE AND RESCUE.....	48

EMERGENCY DRILLS.

EMERGENCIES IN GENERAL.

(See I 2506.)

301. Definitions.—Emergency drills include collision drill, fire drill, abandon ship drill and rescue drill.

302. Emergency signal.—For all emergency drills the *general alarm* shall be sounded before the distinguishing call for the drill. Emergency signals and calls shall not be used for any other purpose than those specified. If emergency signals are sounded inadvertently, the officer of the deck shall, without delay, sound the "secure."

303. Officer of the deck.—In all emergencies the officer of the deck shall sound the proper alarm and take the steps necessary to insure the safety of the ship and of the personnel, and shall inform the captain and the executive of the situation.

304. Arms.—Officers shall wear pistol in service belt and carry ammunition.

305. Silence.—On all occasions of emergency, silence is the first requisite of discipline. Unnecessary noise of any kind makes for confusion. Those in authority are the only ones whose voices should be heard.

306. Stations.—Every officer and man shall go to his station at once. Those men who have no specific duties shall fall in at quarters and keep silence.

307. Details.—In each division stations and duties should be assigned on the basis of the watch bill, by squads of the sections. The squad leaders are responsible for the duty assigned to the squad, and shall be made responsible to the petty officer in charge of the section. Petty officers in charge of sections are responsible to the petty officer in charge of the watch. The petty officers in charge of the starboard and port watches are responsible to the division officer. Squads are the convenient subdivisions of a section as designated by the division officer. Assignment of duties must provide for the most serious circumstances.

308. Calling officers at night.—Provision shall be made for calling officers and special details at night.

309. Communications.—Central should always be informed of the location or character of an injury or emergency, or of the purpose of the exercise, and should transmit the information to the engine room and to other stations. For collision and fire drills, the ship's interior communication system shall be used for the "ready" report, which report shall be transmitted also by messenger.

310. Secure.—*Bugle call No. 10.* After *secure* all hands, except those on watch, shall fall in and remain at quarters until "retreat." The report "secure" shall be made in person by the senior present of each division.

311. Retreat.—*Bugle call No. 12.* *Retreat* shall not be sounded until all divisions have reported secure.

312. Hammocks clear of passages.—Those men, whose hammocks are billeted in gangways, will each take one turn of the lashing around the belly of his hammock and sling it clear of the passageway. The billets, which come under this category, should be specially designated by the division officer, and so marked.

313. Personnel casualties.—Personnel casualties should be prepared for and simulated at all emergency drills. The members of the *band* should be permanently detailed as stretchermen. At emergency drills they shall assemble, under the command of the medical officer, to answer calls to transport the sick or injured. The medical officer is responsible for the detailed instruction of the stretchermen. (*See call No. 46.*)

314. Pilot ladders, fenders and boat spars.—Every ship should provide herself with fenders, and pilot ladders, with flat treads, ready to be dropped over the side when manning boats. Boat spars should be stowed and fitted so that they can be struck into the boats before the boats are lowered.

WATERTIGHT INTEGRITY.

315. General rule.—The doors and hatches of all compartments must, when closed, be dogged tight.

316. Organization for.—The organization must provide for closing the watertight doors and hatches designated to be closed during maneuvers, in fog, or as a matter of routine at night.

317. The calls.—

(a) *Watertight doors* on the bugle. (*Call No. 23.*)

(b) The howlers.

318. Closing power operated doors.—Following the warning howlers, invariably the power operated doors must be closed from the bridge for test.

319. Duties.—Designated doors and hatches which are closed by the divisions or departments shall be reported as closed to the officer of the deck by the senior petty officers. The report from the engineering department shall be made by the officer or petty officer of the watch over the interior communication system. Division officers are responsible for the watertight integrity of their parts of the ship. The officer of the deck, when all reports have been received, shall report all closed to the executive.

320. Remarks.—Doors and hatches when closed at this call are not to be opened without the permission of the officer of the deck. At daylight or after maneuvers, or when a fog lifts, these doors and hatches would be opened on the word being passed "Open up doors and hatches."

COLLISION.

[See I 2506 and I 2605 (1).]

321. At anchor.—The officer of the deck shall be prepared to veer, to rig in the booms and to clear the side as far as practicable.

322. The calls.—

- (1) Emergency signals:
 - (a) General alarm.
 - (b) One long blast of the siren.
 - (c) The warning howlers.
 - (d) Word passed by boatswain's mate as to location of the injury.
 - (e) The *assembly* on the bugle. (*Call No. 8.*)
- (2) Secure signals:
 - (a) Three blasts on the siren.
 - (b) *Secure* on the bugle.
 - (c) "Secure" by boatswain's mate.
 - (d) "Secure" over interior communication system.

323. Officers' stations and duties.—

- (1) Executive in general charge.
- (2) Gunnery officer shall take immediate charge of the placing of the collision mat, and exercise supervision over the divers.
- (3) Navigating officer shall inform himself of the course and distance to the nearest shore, be prepared to serve out charts or navigating outfits and relieve the deck.
- (4) Engineer officer shall see that the pumps are started and are put on flooded compartments or on the drainage system; and shall keep the executive informed as to the condition of all compartments within the limits of his department.
- (5) First lieutenant shall aid the executive, assist in localizing the damage and assure himself that the valves and arrangements outside the engineer's department permit the pumping of damaged compartments.
- (6) Medical officer at the sick bay shall make preliminary provision for removal of sick; and shall be prepared to receive injured or to dispatch a first aid party.
- (7) Pay officer shall be prepared to supply store room keys, and shall make preliminary provision for saving public money and records.

324. General duties.—

- (1) Close watertight doors and fall in at quarters.
- (2) Prepare the collision mat; get it over if ordered.
- (3) Pump out all flooded compartments.
- (4) Localize the flooding as much as possible by closing valves and shoring bulkheads.
- (5) Rig and man diving outfit, and prepare to get diver over the side.
- (6) Man life boats. Prepare to lower all other boats. Be prepared to rescue or render assistance.
- (7) Release prisoners.
- (8) Prepare to remove sick.
- (9) If at anchor, prepare to get under way.
- (10) At night man searchlights.

325. Detailed duties.—Doors, hatches and valves should be grouped, and groups assigned to squads. At drill it is important to require every "dog" to be secure, and defects which prevent the efficient closing of doors, hatches or valves to be reported to the division officer at once. These defects shall be immediately remedied.

326. Escapes.—The collision bill shall indicate the escapes to the upper deck. Care shall be exercised that no man is sealed up in a compartment.

327. Collision, or underwater damage, at general quarters.—No emergency signal shall be made. The senior present in the endangered locality, using men available and the assisting repair crew, will localize the damage.

FIRE.

[See I 2506 (5).]

328. General instructions.—Any person discovering fire aboard ship will endeavor to extinguish it, or prevent the spread of flames. Use will be made of fire extinguishers and other special appliances immediately available. Word shall be sent at once to the officer of the deck.

329. The calls.—

- (1) Emergency signals:
 - (a) General alarm.
 - (b) Ship's bell rung rapidly, followed by designating strokes to indicate location.
 - (c) *Fire quarters* on the bugle (*call No. 31*) followed by the same number of blasts to indicate location.
 - (d) Word passed by boatswain's mate as to location of the fire.

(2) Secure signals:

- (a) *Secure* on the bugle.
- (b) "Secure" by boatswain's mate.
- (c) "Secure" over interior communication system.

330. Officers' stations and duties.—

- (1) Executive at scene of fire in charge.
- (2) Gunnery officer shall have men stationed at flood cocks and sprinkler valves; be prepared to flood threatened magazines or shell rooms; have dry primers and detonators removed from vicinity of fire.
- (3) Navigating officer shall relieve the deck.
- (4) Engineer officer, engine room. He shall have an officer stationed at the steam fire extinguishing manifold, and at the chemical extinguishing valve, if the fire is in a compartment so piped.
- (5) First lieutenant shall aid the executive.
- (6) Medical officer at the sick bay shall make preliminary provision for removal of sick; and shall be prepared to receive injured or to dispatch a first aid party.
- (7) Pay officer shall assure himself that storeroom keys are supplied; and make preliminary provision for saving public money and records.

331. Special details.—The following special details shall assemble well clear, but near the scene of the fire, under the command of the carpenter:

- (1) Repair crew, with tools.
- (2) Fire extinguishers details.
- (3) Rescue breathing apparatus details.

332. General duties.—

- (1) Connect up and lead out hose to all fire plugs in vicinity of fire. Divisions that are remote from the fire will use their hose to extend other lines.
- (2) Put pumps on fire main.
- (3) Serve out flood cock, magazine and storeroom keys.
- (4) Flood magazines and shellrooms, if necessary.
- (5) Remove explosives, gasoline, oils and other inflammable material from vicinity of fire.
- (6) Close air ports, doors and hatches where necessary. Care should be taken not to cut off or close unnecessarily the passages and hatches used for access and for communication.
- (7) Men having charge of storerooms will stand by them with keys.
- (8) Stop blowers or close valves in air ducts where they supply air to the fire.
- (9) Be prepared to light up vicinity of fire with portables, lanterns or electric "bulls'-eyes."

- (10) If alongside a dock or other vessel, prepare to cast off.
- (11) If at anchor, prepare to weigh or slip.
- (12) Remove sick and prisoners to place of safety.

333. Testing equipment.—All fire extinguishing apparatus and equipment shall be tested at routine times to insure its efficiency.

334. Care of particular compartments.—Attention is called to the following articles: I 3328, 3329, 3376, 3377, 3378, 3391, 3392, 3397, as to the care to be observed with coal, fuel oils, gasoline and kerosene on board ship. Coal bunkers, paint lockers, store-rooms and compartments where fires are most apt to occur should be kept under careful surveillance.

335. Fire extinguishers.—

(1) Hand grenades still remain on some ships, but they are becoming obsolete, and none are now purchased.

(2) Oil burning and fuel oil carrying ships are furnished with special fire extinguishers for fighting fuel oil fires, as follows:

(a) CO₂ apparatus, permanently installed, piped to compartments in which fuel oil leaks might occur and to paint mixing rooms.

(b) Foam type apparatus, permanently installed in the fire rooms of oil burning destroyers.

(c) Portable foam type extinguishers kept in fire rooms, engine rooms and compartments adjacent to fuel oil tanks, or compartments through which fuel oil piping runs.

(3) Each submarine is furnished with:

(a) Two portable foam type extinguishers.

(b) Not less than six portable carbon tetrachloride type extinguishers.

(4) Each gasoline motor boat is furnished with a small portable foam type extinguisher, and in addition shall be required to carry a bucket or box of dry sand.

(5) Instructions for testing and the use of extinguishers are furnished with each.

(6) The CO₂ apparatus acts by smothering the fire with CO₂ gas, and is operated from a manifold at a distance from the fire.

(7) The foam type extinguishers, both permanent and portable, act by releasing a heavy foam which smothers an oil, gasoline or other fire by spreading over the surface and excluding the air. This type, although originally designed to combat fuel oil and gasoline fires, has also been found to be more efficient for other fires than the old fashioned chemical type. The permanent foam type is operated by a valve and hose in the fire room in which it is installed. The portable foam type is operated by up-ending the extinguisher.

(8) The carbon tetrachloride type is of particular value on a fire of electric origin, because the liquid thrown on the fire is a non-conductor. This type is usually fitted with a hand pump.

336. Rescue breathing apparatus.—The saving of life, if not of the ship, may depend on the ability to send men into compartments filled with irrespirable gas. Intelligent men should be drilled in the care and operation of rescue breathing apparatus, and should be able to find their way into any compartment, to locate flood cocks, and to work despite the presence of noxious gases. These details should be composed of members of the repair party who would be available in action.

337. Fire at general quarters.—Will be fought by the officer and men at the scene of the fire. As far as practicable, the fire of engaged guns must not be interrupted. Effort must be directed to prevent the spread of flames, to remove spare ammunition to a safe distance, to divert chains of ammunition passers passing too close to the fire, and to isolate endangered magazines, flooding them if necessary.

ABANDON SHIP.

338. General requirements of the bill.—The bill shall provide for:

I.

Getting boats out and manning them as quickly as possible, providing nothing but a life jacket for each man; as, when in company, other ships may be depended on for assistance.

II.

Provisioning, equipping and manning boats; as when acting singly.

339. The calls.—

(1) Emergency signals:

FOR I.

(a) General alarm.

(b) *Abandon ship* on the bugle (*call No. 30*), followed by *double time* on the bugle (*call No. 71*).

(c) The boatswain's pipe "All hands abandon ship."

FOR II.

(a) General alarm.

(b) *Provisions* on the bugle (*call No. 18*), followed by *abandon ship* on the bugle (*call No. 30*).

(c) The boatswain's pipe "All hands provide and equip for abandon ship."

(2) Secure signals:

(a) *Secure* on the bugle.

(b) "Secure" by boatswain's mate.

(c) "Secure" over interior communication system.

340. Stations and duties.—

(1) Executive in general charge.

(2) Gunnery officer and (5) first lieutenant shall take immediate charge of embarkation, each on one side of the ship.

(3) Navigating officer shall relieve the deck, prepared to give the course and distance to land.

(4) Engineer officer and his assistants to repair to their stations in engine and fire rooms. All petty officers of the engineer department to take steaming stations, relieving as many of the unrated men as possible.

(5) First lieutenant. See (2).

(6) Medical officer shall supervise the transportation of the sick and injured to the FIRST crews.

(7) Pay officer shall save the public money and accounts.

(8) The ship's company shall be detailed into FIRST crews and SECOND crews.

(9) Of the officers, generally, the juniors should be detailed to the FIRST crews; the seniors should be detailed to the SECOND crews. Of the men, the junior ratings should generally be detailed to the FIRST crews.

(10) Provide every man and officer with a life jacket.

(11) SECOND crews shall assemble clear of the boats on the bridges and the superstructures.

(12) FIRST crews shall assemble adjacent to boats.

(13) The deck petty officers of the SECOND crews shall assist in getting out the boats for the FIRST crews.

(14) The prisoners shall be released.

(15) At the proper time, notification shall be sent to officers and men below, who then secure boilers and machinery and join the SECOND crews.

(16) Reasonable provision shall be made looking to saving logs, records and muster rolls. Confidential books and papers *must* be saved or destroyed.

341. Boat capacities and allowances.—

Boat Name.	Carrying capacity.	Abandon ship water B. S. and A. C.	Abandon ship water all other ships.	Breakers belonging to boat.	Additional 8-gal.-lon breakers for abandon for ship (except for B. S. and A. C.).
50-ft. steamer	<i>Men.</i> 44	<i>Gal.</i> 22	<i>Gal.</i> 66	2 8-gal. 1 5- "	6
40-ft. steamer	29	15	44	2 8- " 1 8- "	4
30-ft. steamer	25	13	38	1 8- " 1 5- "	3
35-ft. motor boat	27	14	41	2 8- " 2 8- "	3
30-ft. motor whaleboat	31	16	47	2 8- " 1 5- "	4
21-ft. motor dory	10	5	15	1 5- " 1 5- "	1
50-ft. motor sailing launch.....	190	95	285	12 8- " 6 8- "	23
40-ft. motor sailing launch.....	90	45	135	6 8- " 6 8- "	11
40-ft. sailing launch	102	51	153	6 8- " 5 8- "	13
36-ft. motor sailing launch.....	70	35	105	5 8- " 4 8- "	8
36-ft. sailing launch	77	39	116	5 8- " 4 8- "	9
33-ft. motor sailing launch.....	50	25	75	4 8- " 4 8- "	5
33-ft. sailing launch	58	29	87	4 8- " 3 8- "	7
30-ft. motor sailing launch.....	40	20	60	3 8- " 3 8- "	5
30-ft. sailing launch	45	23	68	3 8- " 2 5- "	6
24-ft. motor sailing launch.....	19	10	29	2 5- " 1 8- "	2
31-ft. racing cutter	18	9	27	1 8- " 2 8- "	3
30-ft. cutter	40	20	60	2 8- " 1 5- "	
28-ft. cutter	33	17	50	2 8- " 1 8- "	4
26-ft. cutter	27	14	41	1 8- " 1 5- "	3
24-ft. cutter	19	10	29	2 5- " 2 8- "	2
30-ft. whaleboat	40*	20	60	2 8- " 1 5- "	5
28-ft. whaleboat	32*	16	48	2 8- " 1 8- "	4
24-ft. whaleboat	23*	12	35	1 8- " 1 5- "	3
20-ft. whaleboat	16*	8	24	2 5- " 2 5- "	2
20-ft. dinghy	14	7	21	2 5- " 1 5- "	1
16-ft. dinghy	10	5	15	1 5- " 1 3- "	1
14-ft. wherry	5	3	8	1 3- " 1 3- "	1
12-ft. wherry	4	2	6		1

* Carrying capacity for new-type boats.

(a) Extra water breakers for abandon ship not required for battleships and armored cruisers.

(b) In case of rough sea, the senior boat officers will diminish the loads as necessary by sending certain of the senior ratings into the SECOND crews.

(c) As there are, in some types of boats, different designs of the same boat in service, and as new designs are developed from

time to time, the capacity shown on a boat's label plate should be taken as authoritative where it differs from the capacity given in the foregoing table.

342. Additional for provisioning and equipping.—

- (1) Officers provide binoculars and *The Deck and Boat Book*.
- (2) The assistant navigator to take chart and navigation gear.

(3) The signal officer to take rockets, pistol and signal stars.

(4) The FIRST crews shall be provided with provisions and equipment as per *The Deck and Boat Book*, Article 108, and in addition four buckets for bailing.

343. Return of boats.—The boats will be brought back by details from the FIRST crews to take off the SECOND crews, and make other trips as required.

FIRE AND RESCUE.

344. Employment.—The fire and rescue party may be called to assist a vessel on fire; to prevent the spread of flames to shipping; to render assistance on shore or to rescue people from a vessel in distress. As the particular emergency cannot be foretold, the entire equipment specified should always be provided. Boats should be commanded by the regular boat officers.

345. The calls.—

- (1) Emergency signals:

(a) General alarm.

(b) *Assembly* on the bugle. (*Call No. 8.*)

(c) The boatswain's pipe "Away fire and rescue party."

- (2) Secure signals:

(a) *Secure* on the bugle.

(b) "Secure" by boatswain's mate.

(c) "Secure" over interior communication system.

346. Organization.—

I. *The rescue detail.*

II. *The fire detail.*

III. *The relief detail.*

IV. *The gun-cotton detail.*

I.

347. The rescue detail.—

(1) *Boats and organization.*—To be taken from the division or divisions that man the *life boats*; each of those divisions to have a complete organization in each watch. A medical officer, with outfit, to stand by to go with this detail. In addition to the regular equipment each boat will take:

(a) One life jacket for each officer and man in the boat.

(b) One ring life buoy fitted with hauling line.

(c) One hand grapnel on a line.

In port a steamer or power boat should be used if immediately available.

II.

348. The fire detail.—

(1) *Boats and organization.*—The boats designated should be those which are quickly hoisted out, adequate, and have motive power. Each watch of the divisions from which the fire details are drawn should contain a complete fire detail, so that, with men on liberty, the organization can handle the emergency. The necessary artificers should be similarly detailed.

(2) *Equipment.*—Each boat should carry its regular equipment excepting spars. The special equipment should be provided by an adjacent division, leaving the fire detail free to man their boats.

(A) The *first boat* to go out should carry:

- (a) Boat officer and crew,
- (b) Artificer with unshackling kit,
- (c) Rescue breathing apparatus detail,
- (d) One life jacket for each officer and man in the boat,
- (e) One ring life buoy fitted with hauling line,
- (f) Two hand lanterns,
- (g) Two foam type extinguishers,
- (h) Six buckets,
- (i) Fire party chest, containing:
 - (1) Two axes,
 - (2) One crowbar,
 - (3) Two grapnels fitted with chain and rope lanyards,
 - (4) Two heaving lines,
 - (5) Six bucket lanyards,
 - (6) Two cold chisels,
 - (7) Two ball and peen hammers,
 - (8) One maul,
 - (9) One stillson wrench.

(B) The *second boat* to go out should carry:

- (a) Boat officer and crew,
- (b) Carpenter or mate,
- (c) Handy-billy pump crew,
- (d) One life jacket for each officer and man in the boat,
- (e) One ring life buoy fitted with hauling line,
- (f) Two hand lanterns,
- (g) One handy-billy pump,
- (h) Two lengths of suction hose with strainer,
- (i) Three lengths of fire hose,
- (j) One nozzle,
- (k) One spanner,
- (l) One reducer,
- (m) One jigger and two straps,
- (n) One five-inch line.

III.

349. The relief detail.—

(1) *Employment*.—

- (a) To relieve or to augment the fire and rescue details.
- (b) To be armed for shore duty to assist the local authorities in preserving order and protecting property.
- (c) To respond to the local fire regulations at a navy yard.

(d) To man additional boats for rescue duty.

(2) *Organization*.—It should be organized for each watch from a division or divisions not furnishing the rescue or fire details.

IV.

350. The gun-cotton detail.—

Organization and employment.—It should be organized for each watch from the torpedo crew, will provide its outfit and stands by to land. It should be commanded by the torpedo officer. (See Demolitions. Part V.)

PART IV

GUN DRILLS

	PAGE
GENERAL NOTES.....	53
NOTES ON SIGHT-SETTING.....	57
MIS-FIRES AND HANG-FIRES.....	58
NOTES ON LOADING.....	62
TURRET GUN DRILLS.....	65
BROADSIDE GUN DRILLS.....	70

GUN DRILLS.

GENERAL NOTES.

401. Instructors.—The duty of a drill officer or an instructor is to impart to the crew a sound knowledge of the gun, mount and drill. Practical results are sought. The first requisite is to get the framework of the instruction into the crew's minds, then the details can gradually be built up. The crew should always understand why each detail of the drill is necessary. A rapid and accurate fire is required; this being thoroughly understood by the green crew, special drills to develop the fine points of loading, sight-setting and pointing are in order. All explanations and instructions should be made as clear, concise and emphatic as possible. When the crew is drilling as a unit the instructor should command "Silence" when he corrects a mistake, in order that the whole crew may have their attention drawn to it.

402. Assignment of stations.—The members of the gun crew are assigned to stations. The titles of the stations are, in a general way, explicative of the duties to be performed.

403. Falling in for muster.—Crews of broadside guns, when falling in for muster abreast the guns, should fall in, in single rank, facing inboard, by size, gun captain on the right.

404. Manner of giving commands.—Officers and instructors must be careful to give commands in a clear and distinct manner.

405. Commands used.—The following commands are used:

- (1) Stations!
- (2) Load!
- (3) Commence Firing!
- (4) Silence!
- (5) Carry on!
- (6) Cease Firing!
- (7) Unload!
- (8) Secure!

(1) *Stations!*—At this command, which may be given at any time or in any formation, the crew go at once to their gun, take their respective stations and await further commands. The gun is supposed to be ready for the exercise required when this command is given.

(2) *Load!*—The crew, being at their stations, go through the operation of loading the gun.

(3) *Commence Firing!*—This command may be given either before or after the gun is loaded. If given before, the gun will be loaded at once. The target having been designated, the firing and service of the gun are started, the pointer firing when the firing signal is given or when on the target, depending upon the nature

of the practice being held. The gun will be loaded as soon as fired, and firing will continue until the ammunition is exhausted or until the command "Cease Firing!"

(4) *Silence!*—This command is given when, for any reason, it is necessary to temporarily stop the service of the gun. It may be given by the division officer or by any member of the crew noticing something requiring immediate attention. When it is given, every member of the crew ceases all operations and stands in his tracks and awaits instructions. If a member of the crew calls "Silence!" he will point out, to the division officer or gun captain, what he has observed.

(5) *Carry On!*—After the command "Silence!", the defect having been remedied, this command is given, at which the crew resume the operation in which they were engaged when the command "Silence!" was given.

(6) *Cease Firing!*—[See I 2860 (4).] The service of the gun is stopped and steps are taken so that the gun cannot be fired. The procedure will depend upon the type of gun, and for this purpose guns may be divided into two classes:

(a) B. L. R. guns (guns using powder in bags and separate primers in locks): Break firing circuit at contact lug and remove primer from lock.

(b) R. F. guns (guns using powder in brass case containing the primer):

I. If charge and projectile are separate, remove the case and close breech.

II. If the charge and projectile are in same case, remove case, *i. e.*, unload.

(7) *Unload!*—[See I 2858 (2) and I 2860 (1).] (a) If the gun will permit, the primer must be removed before the plug is opened. If this is done, the powder may be removed without fear of accident. With R. F. guns the plug should be opened cautiously.

(b) When it is apparent that the service of the gun will not be resumed within a reasonable time, the powder which has been unloaded must be dumped into distilled water.

(8) *Secure!*—(a) At this command the ammunition will be returned to the magazine; spare parts returned to their places; unnecessary gear stowed away and guns and turrets secured.

(b) If the gun has been fired, as soon as possible after the firing has ceased, the gun should be thoroughly washed out, dried and oiled. If practicable, this should be done while the gun is still hot.

406. Preparing the battery for exercise.—

(1) At Clear Ship for Action the guns are prepared without further command and many preparations made which, at general quarters for exercise, are omitted. [See *Clear Ship for Action*,

Part II.] The following list of preparations, when clearing for action, is not complete, but is given as a guide:

- (a) Open hood shutters and provide material for wiping off sight lenses.
- (b) Examine training and elevating gear, including motors, to be sure they are in good working order.
- (c) Test all the fire control apparatus.
- (d) Test fire extinguishing system.
- (e) Take out tompons.
- (f) Take off turn buckles, out centering pin, release wedges, raise water shed and remove port shutters, if fitted.
- (g) Provide sponges, buckets, gun tubs and powder drowning tanks and fill with water.
- (h) Supply spare parts and accessories.
- (i) Provide tools that might be necessary in case of breakdown.
- (j) Connect up firing circuit and test it for grounds and faulty connections. Fire primers with both battery and motor generator. Try percussion firing.
- (k) Examine breech and firing mechanism parts.
- (l) Have spare gas check pad ready.
- (m) Inspect and test gas ejector system.
- (n) Examine powder bags and shell, if time permits.
- (o) Provide loading tray and hand rammer.
- (p) Provide first aid outfit.

(2) When the ship is not cleared for action, at the *call to general quarters*, the crew will immediately go to their stations and prepare for the *exercise of the gun crew*. For example, as the crew should be exercised at "fire in action," the fire hose should be led out; as the guns must be trained, all ship gear that interferes therewith must be removed. Duties which are performed at Clear Ship for Action and which do not affect the *drill of the crew* will not be performed when at general quarters for exercise.

(a) Spare parts, kept in the storeroom, will not be provided, but will be gotten up from the storeroom when needed during the drill.

(b) Telescope sights, if not on the gun, should be kept in boxes close to the gun and should be shipped at general quarters.

(c) When at general quarters for exercise, guns will not be provided with service ammunition. In order to test the ammunition hoists of broadside guns the following dummy charges should be prepared:

For each broadside gun of 54-inch caliber or above, 2 charges.
For each gun below 5-inch caliber, 1 box.

These should be sent to the guns at general quarters for exercise. If there is sufficient target practice ammunition on board

at any time, such ammunition may, at the discretion of the commanding officer, be used for drill.

(d) Gun swabs, bristle-bore and marine sponges, gun tubs and buckets, as allowed by the Bureau of Ordnance, should be provided at the guns at general quarters.

(e) Firing circuits need not be put on the guns unless drill primers are to be fired.

(f) Tompions must be removed.

407. Details for providing.—The detailing of the members of the crew for the performance of the individual duties in getting the battery ready is left to the discretion of the division officer whose duty it is to see that his battery is ready, in all respects, as expeditiously as possible for the drill or exercise that is to be carried out.

408. Division officers responsible.—Division officers, being responsible, must assure themselves, either by personal inspection or through reports from their gun captains, that their battery is, in all respects, ready for the exercise required before reporting ready to the fire control officer.

409. Casualties to matériel.—(1) *Casualty drills.*—The attention of all officers is called to the absolute necessity of drilling the gun crews at *casualty drills*—i. e., casualties to both men and matériel. No matter how efficient the crew may be at loading, sooner or later a breakdown or interruption may occur. Then it is of vital importance that the crew be prepared to remedy the defect in the shortest possible time, in order that the services of the gun may not be lost to the ship. To this end officers must not only explain to the crews what to do in case of any probable casualty, but must *actually drill them in doing it*. To neglect this is fatal.

(2) *List of casualties.*—Study reports of target practice and see what has happened to others; make notes of what happens during drill. Any of these things may happen during practice. The following is a brief list of the most frequent casualties, but does not, by any means, include all that may occur:

- (a) Broken rammer.
- (b) Broken powder bag.
- (c) Burning fragments on mush room or in powder chamber.
- (d) Circuit breaker blows.
- (e) Fire in turret or in vicinity of broadside gun.
- (f) Firing circuit cut or jarred loose.
- (g) Gas ejector fails.
- (h) Hoist cable carries away.
- (i) Lights out.
- (j) Mis-fires.
- (k) Plug will not open or will not close.

- (l) Powder bag comes wrong end toward gun.
- (m) Shell does not seat.
- (n) Signal system (if used) fails.
- (o) Vent becomes choked.
- (p) Primer blow back fusing the metal of primer case or the firing pin.

410. Casualties to personnel.—(1) *Casualty drills.*—In case of injury to any member or members of the crew, the gun crew must be drilled so that those remaining will continue the service of the gun. It is to be expected that, in this case, the service will not be as efficient as before the casualty; but it must be distinctly understood that no gun is to be abandoned, even by the last remaining man, as long as it can be loaded and fired. For the above reason every man in a well trained gun crew should be familiar with the duties of every other station, and should be prepared to perform them without hesitation.

(2) *Removal of personnel casualties.*—The removal of casualties is a matter to be specially provided for in each ship. It is the duty of the gun crew to continue the service of the gun and to overcome every obstacle which interferes therewith. The gun crew will therefore not cease their operations of loading, but two men nearest to the wounded man should, without orders, place him in any convenient position clear of the working of the gun, whence he will be given first aid treatment, then removed, as elsewhere specified. The operations of loading or firing will never be discontinued for the purpose of removing personnel casualties, except in cases of absolute necessity.

NOTES ON SIGHT-SETTING.

411. Necessity for accuracy.—The proper setting of the sights of a gun is absolutely essential to accuracy of fire. No matter how efficient the rest of the crew may be, the accuracy of the gun can be ruined by poor sight-setting.

412. Selection of sight-setter.—The sight-setter should be carefully selected. In turrets, he is usually the second or relief pointer or trainer. For broadside guns he is an additional man. He need not be a large man or a man of great strength, but he must be steady, attentive and not gun-shy. He must be a man that can hear over a telephone and voice tube; not every man can.

413. Method of training.—After the sight scales have been explained to the sight-setter and he has been shown how to manipulate the mechanism, he must be drilled at sight-setting. He should be trained to approach the setting slowly and not pass it and have to come back to it. This drill should be carried out daily for ten or fifteen minutes until he is proficient, and then

often enough to keep him so. The orders for the setting—*i. e.*, the actual ranges and deflections—should come over the regular fire control system to accustom the sight-setter to its use. This may not always be practicable, but should be done if possible. The setting should be carefully checked by a responsible person, preferably the division officer himself, or, if this is not possible, the gun captain. Accuracy should first be insisted upon, and, when this is acquired, speed should be developed. Many shots miss the target because of slow or inaccurate sight-setting.

MIS-FIRES AND HANG-FIRES.

414. Definition of mis-fire.—A mis-fire occurs when the pointer attempts to fire the gun and the charge fails to explode.

415. Classification.—Mis-fires may be divided into two classes:

(1) Primer mis-fires, when the primer fails to explode.

(2) Charge mis-fires, when the primer explodes, but the charge fails to explode.

416. Definition of hang-fire.—A hang-fire occurs when there is an appreciable interval between the *attempt* to fire and the explosion of the charge. It is evident that a hang-fire can occur only after an apparent charge mis-fire.

417. Causes of primer mis-fires.—The most frequent causes of primer mis-fires are:

(1) Electric:

(a) Failure of pointer to close contact.

(b) Poor or broken connections; not carefully tested before firing or jarred out, or cut during firing.

(c) Ground on the circuit.

(d) Dirt or grease on primer or contact lugs.

(e) Insufficient voltage—battery run down.

(f) Defective primer—rare.

(2) Percussion:

(a) Broken firing pin.

(b) Weak main spring.

(c) Dirt under firing pin shoulder.

(d) Firing pin not directly over cap of the primer.

(e) Defective primer—rare.

418. Causes of charge mis-fires and hang-fires.—The most frequent causes of charge mis-fires and hang-fires are:

(1) Powder loaded in wrong—ignition end of charge forward.

(2) Powder shoved in too far—exceedingly rare.

(3) Powder wet.

419. Classification of guns for consideration of mis-fires and hang-fires.—Guns may be divided into three classes, as follows:

(1) B. L. R. guns (guns using combination primers in locks that permit of removing the primer without opening the breech).

(2) Guns using combination primers in a brass case.

(3) Guns using percussion primers in a brass case.

420. Procedure.—(1) The following tables are given as the simplest means of showing the procedure in case of a mis-fire, always bearing in mind that a charge mis-fire may, at any time, develop into a hang-fire. In making out Tables I and II, it is taken for granted that electric firing is the primary method, and that where both a battery and a motor generator circuit are fitted both will be tried before the pointer calls "mis-fire."

(2) The rules of procedure are drawn up on the following general principles:

(a) That every effort consistent with safety shall be made to fire the gun.

(b) That none of the means taken to fire it shall involve any risk of an accident by unlocking the breech during a possible hang-fire.

(3) The words "Fires" and "Mis-fires" in the tables refer to the charge and not to the primer.

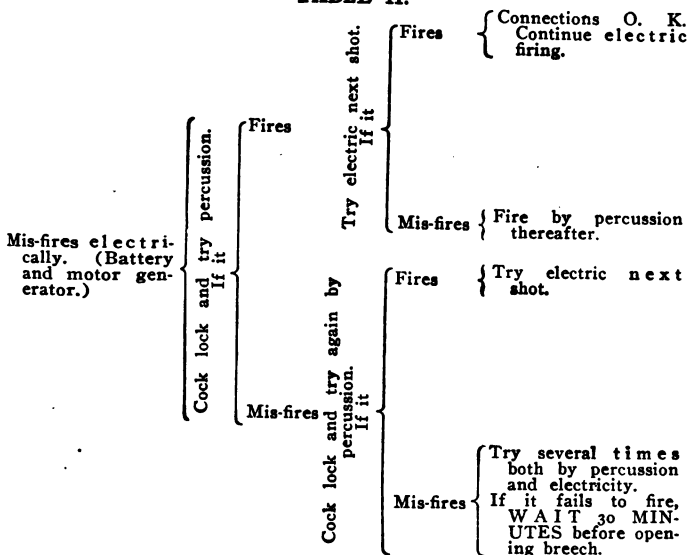
421. Procedure for B. L. R. guns (guns using combination primers in locks that permit of removing the primer without opening the breech).—

TABLE I.

Mis-fires electrically. (Battery and motor generator.)	Cock lock and try percussion. If it	Fires	Examine connections and try electric on next shot. If it	Fires	Connections are O. K. Continue electric firing.
				Mis-fires	Use percussion firing thereafter.
		Mis-fires	Extract primer and see if it has exploded. Insert new primer and try electrically. If it	Fires	Connections are O. K. Continue electric firing.
				Mis-fires	Try percussion. If primers are found to have exploded, continue to fire primers as long as there is a reasonable chance of igniting the charge. If the primers have not exploded (which will rarely be the case) keep trying new ones until one explodes. If all attempts fail to explode the charge but you have succeeded in exploding primers WAIT 30 MINUTES before opening breech.

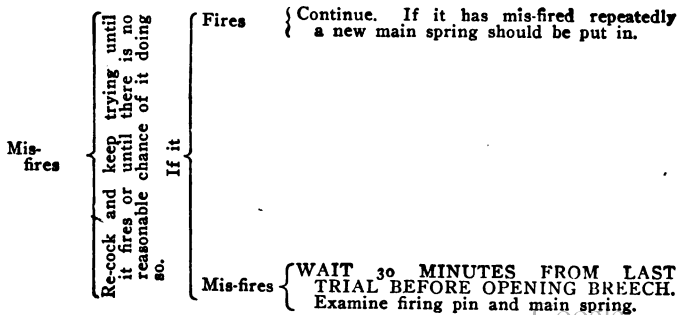
422. Procedure for guns using combination primers in cartridge cases.—

TABLE II.



423. Procedure for guns using percussion (only) primers in cartridge cases.—

TABLE III.



424. Use of priming tools.—In removing and inserting primers in turret guns, after a mis-fire, the tools issued for the purpose should be used. In case the mis-fire should develop into a hang-fire, the recoil of the gun might seriously injure anyone attempting to prime without the use of the tool.

425. Calling mis-fire.—Too much emphasis cannot be laid upon the necessity for the pointer IMMEDIATELY calling "Mis-fire" as soon as he realizes that his gun has not fired after he has tried both electric circuits.

426. Procedure in time of war.—Where the possible chances of serious danger due to mis-fires may be overbalanced by the more important considerations of battle, the commanding officer may, at his discretion, decide what interval shall intervene between the occurrence of a mis-fire and the opening of the breech. [I 2865 (5).]

NOTES ON LOADING.

427. Rapidity of loading.—Rapidity of loading depends upon:

(1) The rapidity with which each member of the gun crew performs his duty.

(2) The precision with which each member of the gun crew performs his allotted portion of the drill.

(3) The team work of the crew as a whole; that is, upon each member of the crew performing his duty in the service of the gun at exactly the proper time and in exactly the proper way and without interference with other members of the crew.

428. Accuracy.—Accuracy and thoroughness in every detail, even though it may require slightly more time, is an absolute requisite to real rapidity of loading. Eagerness for excessive rapidity may result in serious delays caused by interference, confusion and casualties that can be avoided only by precision in every movement. It must be remembered that these delays may more seriously interfere with the rapidity of fire than the deliberation necessary to avoid them.

429. Movement required in loading.—In devising a drill for a gun it should be borne in mind that the less movement required of the members of the crew, the less liable they are to interfere with each other, or to be in one place when they should be in another. This is especially true of broadside guns to which the ammunition must be brought by hand. For this reason it is very much better to have one man, the first shellman, load all the shells, and have the other shellmen keep him supplied therewith, than to have them alternate in loading the shells, each providing shells for himself. The same is true of the powdermen. The less movement required the better.

430. Development of loading drill.—The aim of every division officer should be to so drill his gun crews that they will work with the precision and certainty of a well regulated machine. In order that this may be accomplished it is necessary that each man thoroughly understands his duties and the best way of performing them. To this end the man should first be told exactly what his duties are and how to perform them; then he should be drilled in their performance. The drill will have to be slow at first, gradually developing speed, but not at the expense of accuracy. When the division officer is satisfied that the crew has reached a satisfactory state of efficiency only enough drill is necessary to keep it from going backward.

431. Amount of drill.—The exact amount of drill necessary will depend upon the type of gun and the individual men. No definite rules can be laid down. In order to stimulate interest and to arouse a spirit of competition among the crews it has been found advantageous to keep the times of a certain number of loads for each crew and at the end of the drill to post the average on the division bulletin board. It is surprising how rapidly the crews will develop when a spirit of friendly rivalry exists among them. This rivalry must never be permitted to go beyond the friendly stage, however.

432. Carelessness in loading.—Careless loading may easily put a gun out of action for a considerable time. For instance, if the screw box is burred badly, the plug will not close; if the powder bag is loaded in wrong end first, a mis-fire or hang-fire may result. It is therefore necessary that the crew reach a high state of efficiency in respect to care of material.

433. General rules in loading.—A few general rules, applicable to nearly all guns, are here given:

(1) *Bore clear.*—Before loading a B. L. R. gun fitted with a gas expelling device and using powder put up in bags, a designated member of the crew will look through the bore and report "Bore Clear." The most available member of the crew will be designated for this duty. This is to guard against failure to remove the tompon before the first shot and thereafter to insure against any foreign matter or inflammable gas being left in the bore.

(2) *Seating shell.*—Experiments have shown that a failure to seat the shell causes a variation in the range of the gun. This is caused by the escape of gases past the shell before it takes in the rifling. It is absolutely required in all guns using separate ammunition (except the 5-inch, in which the shell can be seated with the powder) that the shell, or shell and powder together, be rammed home with a rammer. Great care should be taken by the rammerman to insure that the shell is properly seated.

(3) *Ignition charge.*—In loading the powder bags in a gun, care must be taken that the ignition charge is always to the rear;

otherwise a mis-fire or hang-fire may result. The last charge to be loaded in should be just clear of the mushroom head.

(4) *Priming*.—The priming of B. L. R. guns while the breech is open is not permitted, and the breech plug must be closed and locked before the primer is inserted in the firing lock, except in those guns where the wedge block, containing the firing pin, is arranged to operate automatically by the functioning of the breech mechanism in such manner that the firing pin cannot be brought opposite the primer until the plug is closed and locked. In the latter case the primer may be put in the lock while the breech is open. With locks that are operated by hand the plug must be closed and locked to within about one-quarter of an inch of contact before the primer is inserted in the lock. After the primer is inserted the plug should be completely locked. If it is desired to fire by percussion, and it is necessary to cock the lock and then fire it with a lanyard, the lanyard must be hooked before the lock is cocked.

(5) *Loading tray*.—Every precaution must be taken against injury to the screw box and gas-check seat. To this end a loading tray must always be used except with fixed ammunition and with B. L. R. guns, in which it has been demonstrated that the gun can be loaded without appreciable danger without a tray.

(6) *Handling ammunition*.—For R. F. guns, the shellmen should provide themselves with knives for cutting the lashings on the boxes and with waste for wiping off the cartridge cases. Before target practice rapid fire ammunition should be gotten up, thoroughly cleaned and tried in the gun, but if at any time the ammunition to be used has not been cleaned and wiped off, the above precautions are necessary. Care must be observed that no waste falls in the screw box or gets in the bore. Sometimes when handling rapid fire ammunition the projectile starts from its seat in the case. This should be looked for and shell reseated before attempting to load or the breech will not close.

(7) *Mushroom*.—When firing B. L. R. guns, the mushroom head must be wiped off with a wet sponge after each shot.

(8) *Firing pin*.—When firing R. F. guns, while the plug is open the plugman should pass his hand over the face of the plug to insure himself that the firing pin is housed properly. This is to guard against having a projecting firing pin strike the primer as the plug swings shut, thus causing a premature explosion and possible disaster.

(9) *Ammunition supply*.—The prompt and regular supply of ammunition is essential to efficiency, therefore actual exercise in that feature is as necessary as is exercise at the gun. Rapid loading, without a corresponding rapid ammunition supply, is without value, and this supply includes every operation from taking the ammunition from the magazine and unboxing it to

loading it in the gun. Especial attention should be given to providing for the disposition of cartridge boxes or powder tanks in such a manner as least to interfere with rapidity of serving the gun.

(10) *Shell slipping*.—Watch the first shell shoved home in a clean gun. If the gun is elevated (as by ship rolling), the shell is very apt to slip back and not be home when the gun is fired. This is caused by oil on the compression slope, and it may occur after the powder charge is home and thus not be seen. Its effect is to reduce the velocity. If the shell is persistent in slipping back, tie a little grommet of small twine around it just forward of the band. If a shell goes home properly it emits a non-mistakable, clear, ringing sound. If it gives a dull thud it is not home.

(11) *Clearing the vent*.—It is seldom necessary to clear the vent. If it be found necessary, the priming wire should be used from the forward end of the plug, care being taken to avoid scoring the primer seat. After clearing the vent with the primer wire, take care to clean thoroughly the primer seat with the vent cleaner. In case of a blowback, the vent and primer seat should be examined for scoring and thoroughly cleaned. The vent drill will not be used except under the direct supervision of an officer.

(12) *Fired primers*.—Keep primers that have been fired out of reach, otherwise somebody may try to use them again. This has not infrequently happened.

TURRET GUN DRILLS.

434. *Detailed drill*.—Owing to the multiplicity of types of turrets in the Navy, to the lack of any standard type that can be given as a guide, and to the impracticability of obtaining the detail drills of every type in service, no drills for turrets are incorporated herein. Turret officers, knowing the peculiarities of their own turrets, are best able to cope with their individual difficulties and develop their own drills. As a partial guide, and to standardize practice, the following general rules are given:

435. *Control of turret*.—When both guns of a turret are being fired the turret officer must still retain perfect control of his turret. The junior officers of the turret and the turret captain are his assistants for this purpose.

436. *Turret stations*.—

(1) *Turret officer*.—The station of the turret officer is habitually in the turret booth. If the turret is not fitted with a booth, as in the 8-inch turret, he must be where he can best exercise his command of the turret.

(2) *Junior officers*.—If there is only one junior officer, his station is usually in charge of the ammunition crew. If there are

two or more, one of them should be in the turret to assist the turret officer. Junior officers should be thoroughly familiar with the operation of the turret, as they may, at any time, be called upon to take command of it.

(3) *Turret captain*.—The turret captain is stationed at the discretion of the turret officer. It is considered best to put him in direct command of one gun, and a junior officer (if available) in direct command of the other, the turret officer supervising both.

(4) *Gunner's mates*.—Every turret has permanently assigned to it one or more gunner's mates. These cannot be used as members of the guns crews, but should be stationed where they will be available in case of breakdown.

(5) *Turret electricians*.—Every turret should have an electrician permanently detailed for duty in the turret, and whose battle station is in the turret. His duties are to keep the electrical installation in good working order, and his battle station is wherever he can best look out for fuses and circuit breakers.

(6) *Gun captain*.—Each gun of a turret should have a gun captain, qualified or acting. He should be selected with great care, due weight being given to ability to handle men, knowledge of the gun and mount, alertness, keenness and judgment. He may have no additional duties, or may occupy a station of the loading crew. In any case he should be in a position to observe and direct the work of the crew.

(7) *Pointers and sight-setters*.—Every gun in a turret must have at least two pointers. These are usually called first and second pointers. There is now a growing tendency in the service to have two sight-setters, one for deflection and the other for range; one wearing the telephone and the other the voice tube. This is recommended if the extra men are available and the construction of the sights and turret permit.

(8) *Trainer and sight-setter*.—Every turret requires a trainer and a trainer's sight-setter. These are usually called first and second trainers. Their stations are, respectively, at the training wheel and the trainer's sight mechanism, and their respective duties are to keep the turret trained on the target, and to keep the sight set according to the orders through the fire control system.

(9) *Messengers*.—It is well to have a messenger in the turret and one in the handling room. The one in the turret should be in the booth with the turret officer, and the one in the handling room should be at the voice tube leading to the turret.

(10) *In charge of handling room*.—When there is no junior officer in charge of the handling room, a petty officer, thoroughly familiar with the drill, should be placed in charge and held accountable.

437. Living in turrets.—Gunner's mates, turret electricians and their helpers should live in the turret, and one of them should always be required to be there. There should be no objection to these men making themselves as comfortable as possible therein, provided the efficiency of the gear is in no way impaired, the turret and handling room kept clean and in order, and abuses against discipline prevented.

438. Giving commands.—Commands involving the whole turret should, of course, be given by the turret officer. The junior officer, or turret captain, in charge of one gun, or the gun captain, may give orders or commands as necessary in the service of his own gun. Unnecessary commands tend to confusion. The drill should be carried out in perfect silence, each man performing his own duty quickly, and with as little interference with others as possible.

439. Loading position.—In those turrets that require the gun to be brought to a loading position (approximate) care should be taken to inform the pointer when the gun is again ready for movement in elevation. This time will vary with different guns, depending upon the method of loading the powder; but in case the pointer is allowed to elevate the gun before the breech is closed, it is especially important that the shell be seated securely to prevent it slipping back out of the breech.

440. Standard gun crew titles.—There is a tendency to carelessness among young officers in naming the different members of a turret crew. For instance, in ships having hand loading turrets the titles of the men stationed under the gun to take powder out of the bin vary widely, as "recoil powderman," "box powderman," etc., and those stationed on platforms to pass up powder some call "tubemen," some "stagemen" and others "platform men." This should be discontinued and the title standardized. The term "loader" should be discontinued. No one man should be called loader; for the crew, with exception of pointers and trainers, are all loaders. The following nomenclature satisfies all requirements, and is applicable to all turrets. It shall be followed in future:

- (1) *Plugman*.—One who operates the plug.
- (2) *Hoistman*.—One who operates a hoist (in two-stage turrets, preceded by word *upper* or *lower*).
- (3) *Rammerman*.—One who operates a rammer, either hand or power.
- (4) *Trayman*.—One whose primary duty is to put in and take out the loading tray.
- (5) *Shellman*.—One whose primary duty is to handle shell.
 - (a) Those in turret numbered *1st*, *2d*, *3d*, etc.
 - (b) Those in shellroom, those in handling room—no numbers necessary.

(6) *Powderman*.—One whose primary duty is to handle powder.

(a) Those in turret numbered *1st, 2d, 3d*, etc.

(b) Those on platforms to pass up powder—*platform powdermen*.

(c) Those in handling room—*handling room powdermen*.

(d) Those in magazine—*magazine powdermen*.

(7) *Signalman*.—One whose primary duty is to operate signals or indicators between turret and handling room.

(8) *Carman*.—In power loading turrets there are sometimes required one or more men who open and close doors on the car (when in rear of the gun), or otherwise trip the powder from the inside of the car to the loading tray. While these men may be called powdermen, it is sometimes better to call them *carmen*. This title should not be used for those turrets in which the powder is put on to the tray by actually picking it up and placing it there, but only for those in which the operation is done without actually handling the powder.

441. Assignment to turret stations.—A man should be stationed in the position that he is best qualified to fill. Each man should be trained for as many stations as practicable, though specially trained for his own particular station. Generally the greater the number of stations a man is capable of filling the better is he able to perform the duties of his own, and the better the duties of those who may be disabled will be absorbed by the remaining members of the crew. The gun captain will be responsible for the service of the gun in action. Gun captains should not be finally selected until the division officer knows his men thoroughly. The gun captain should not be recommended for examination until he has been through at least one target practice while acting in that capacity. Plugmen should be strong, quick and steady. Men who are mentally quick should be selected to run electric gear, rammers, hoists, etc.

442. Preliminary instruction in loading.—Having tentatively stationed the gun crews, the first drill periods should be devoted to explaining and demonstrating the gear. The men should be taught at this time the general scheme of loading, nomenclature of parts, the necessity for precision and safety regulations. After these are understood the individuals should be drilled in their particular duties. Each movement of each man should be studied until the best, surest and quickest method of accomplishing each task is discovered. Insist upon precision rather than speed. The candidate for each position should carefully practice his part until fairly proficient, and then the crew can be given exercise in loading.

443. Loading exercises.—In the complicated power loading turrets save the gear as much as possible. After a load criticise in detail each mistake. Then load once more, and repeat the lec-

ture. It is a frequent and bad practice to slam through seven or eight loads, all imperfect in some detail.

444. Timing loads.—As soon as the crews can load with precision begin to pit them against one another. Speed in loading is the natural result of precision and team work. In the event of mishaps always have the fault remedied as would be the case in service, and *always complete every load that is attempted*. The time should be taken from shot to shot, as seconds saved in loading may be readily lost by the pointer.

445. Priming.—The plugman should practice priming many times a day until proficient.

446. Powder passing.—If the powder is passed by hand, the passers should be required to pass at least fifty bags a day. This can be accomplished by sending the bags up on one side of the turret and down on the other. Care must be exercised to always have the strap end of the bag uppermost, and that this strap is not used in passing the bags. The powder passers should be drilled daily until they are developed, and can continue their duties without becoming fatigued. Every individual who handles the powder must understand that the ignition end of all bags must be toward the breech. Instruction must be given regarding the care to be taken in handling bags—the breaking of a single powder bag may interrupt or delay the firing, and should not occur.

447. Training of pointers.—Having become familiar with the gun and its appurtenances, the candidate for pointer should be taught the significance of the “stand by” and the “firing” signals, the time interval to be used, etc., the necessity of being “on” when he fires, to “hold fire” if he is not “on,” and in general given a thorough knowledge of the system of spotting and fire control. It is not sufficient to tell a pointer that “the better the pointing the poorer the results if the sights are incorrectly set.” He must be told *why*. He should understand enough of the principles of fire control to know *why* implicit obedience to the orders of the spotter is necessary, and why an attempted betterment of the spotter’s corrections will certainly result in disaster. He should understand the firing connections, the methods of firing, and the safety precautions. After instruction has been given the candidate for pointer, he should be put through exhaustive tests. The time to be spent on each man will vary considerably, but sufficient time must be allowed to give each candidate a thorough and impartial examination. Too little attention is sometimes paid to the *CONSISTENT* drilling of pointers. The turret should be in a state of preparedness at all times, and should have an adequate supply of expert gun pointers.

448. Selection of pointers to continue training.—Some men will soon begin to do better than others, the groups of candidates should be rearranged, putting the best men together. The best and steadiest should be tried at training, as this is the more diffi-

cult position. After a few drills and trials of different groups, the poorer ones can be dropped, and the entire time devoted to the training of those who have shown themselves to be the most promising.

449. Safety.—*All safety regulations must be strictly obeyed.* In stationing the crew regard must be had to their safety under all conditions. Arrangements must be made so that ammunition cars can be loaded in safety. The turret officer is responsible for the crew, and every precaution should be taken to avoid accidents to them.

BROADSIDE GUN DRILLS.

450. Drills.—The following drills for broadside guns are those which have given the best results in service. While strict compliance with them is not mandatory, it is believed that they are the best that have been developed to date, and they should be followed until opportunity to observe results and experience sufficient to lead to improving them have been had.

451. Drill of 7-inch 45-caliber B. L. R.—

(1) *Titles and stations of gun crew.*—

TITLE.	STATION.
Gun captain (if extra man)	Where he can best direct crew.
Plugman	At operating lever.
Pointer	At elevating wheel.
Trainer	At training wheel.
Sight-setter	At sight mechanism.
1st trayman	At right front handle of tray.
2d trayman	At left front handle of tray.
3d trayman	At right rear handle of tray.
4th trayman	At left rear handle of tray.
1st rammerman	To rear and right of tray.
2d rammerman	To rear and left of tray.
1st shellman	To left of tray.
2d shellman	} Provide shell to 1st shellman.
3d shellman	
1st powderman	} To right of tray.
2d powderman	
3d powderman	
4th powderman	} Provide powder from hoist. *

NOTE.—Some of the above stations may have to be changed, owing to structural arrangement of the ship, or to the location of the ammunition supply. More or less shellmen may be required, depending upon the facility with which ammunition can be supplied or upon the number of men available. It may be necessary, in case of unusual shorthandedness, to have the shellmen and powdermen act also as traymen. Some officers prefer to have a separate man act as primerman. This leaves the plugman free to wipe off the mushroom and watch the work of the crew.

(2) *Commands.*—

(a) *Stations!*—The crew to go to stations preparatory to loading and firing the gun.

(b) *Load!*—(The gun having been fired.)

Pointer and trainer keep gun on target.

Sight-setter keeps sight set.

Plugman opens breech and inserts new primer; wipes off mushroom.

4th trayman calls "Bore Clear!"

All traymen at signal from the 1st trayman, lift tray and swing it forward into breach smartly to start shell. Withdraw tray when charge is clear of it.

2d trayman closes air valve.

Rammerman rams charge (shell and powder) home and withdraws rammer. Places end of rammer against rear powder bag on tray as soon as it has been re-loaded.

Plugman closes breech and calls out "Ready!"

1st shellman places shell on forward end of tray as soon as it is in position after being withdrawn.

1st and 2d powdermen place forward and after sections of powder on tray in rear of shell for next load.

Other shellmen and powdermen provide shell and powder in handy position.

(c) *Commence firing!*—This command may be given either before or after the gun is loaded. If given before, the gun will be loaded at once. The firing and service of the gun are started, the pointer firing when the firing signal is given, or when he is on the target, depending upon the nature of the practice being held. The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted, or until the command "Cease Firing!"

(d) *Cease firing!*—[See I 2860 (4).] The service of the gun is stopped. If the gun is loaded, the plugman rotates the plug far enough to break the firing circuit, and then extracts the primer.

(e) *Unload!*—[See I 2858 (2), I 2860 (1), and paragraphs 6 and 8 (a) of General Order No. 185 of May 11, 1912.]

Plugman opens breech.

Powdermen withdraw powder.

Shellmen withdraw shell. (It may be necessary to ram shell out from the muzzle with boom.)

(f) *Secure!*—The members of the crew, under the supervision of the gun captain, return everything that has been provided and secure the gun. If the gun has actually been fired, the crew will assist the gunner's mate in washing out and oiling the bore. Crew fall in for muster.

452. Drill of 6-inch 50-caliber B. L. R.—**(1) Titles and stations of gun crew.—**

TITLE.	STATION.
Plugman and gun captain.	At operating lever.
Pointer	At elevating wheel.
Trainer	At training wheel.
Sight-setter	At sight mechanism.
Trayman	Left and rear of breech.
Rammerman	Rear of breech.
1st shellman.....	Left and rear of breech.
2d shellman.....	Rear of first shellman.
3d shellman.....	At ammunition supply.
1st powderman.....	Right and rear of breech.
2d powderman.....	Rear of first powderman.
3d powderman.....	At ammunition supply.

NOTE.—More or less shellmen and powdermen may be required depending upon the facility with which ammunition can be supplied from the hoist. Some officers prefer an additional man as primerman. This leaves the plugman free to wipe off the mushroom head and watch the loading.

(2) Commands.—

(a) *Stations!*—The members of the crew go to their stations preparatory to loading and firing the gun.

(b) *Load!*—(The gun having been fired.)

Pointer and trainer keep gun on target.

Sight-setter sets sights as ordered.

Plugman opens breech, puts in new primer, wipes off mushroom head.

Trayman inserts tray and closes air valve.

Rammerman calls "Bore Clear!" rams shell home as soon as it is in the bore, making sure to seat the shell, withdraws rammer quickly.

1st shellman, as soon as bore is clear, throws in shell and gets another from 2d shellman.

1st powderman loads in powder as soon as rammer is withdrawn, and gets new charge from 2d powderman.

Trayman withdraws tray.

Plugman closes breech and calls out "Ready!"

Other shellmen and powdermen supply shell and powder to 1st shellman and 1st powderman.

(c) *Commence firing!*—This order may be given either before or after the gun is loaded. If it is given before, the gun will be loaded at once. The firing and service of the gun are started, the pointer firing when the firing signal is given, or when he is on the target, depending upon the kind of practice being held. The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted, or until the command "Cease Firing!"

(d) *Cease firing!*—[See I 2860 (4).] The service of the gun is stopped. If the gun is loaded, the plugman pulls lever far enough to break the firing circuit, and then extracts the primer.

(e) *Unload!*—[See I 2858 (2) and I 2860 (1).]

Plugman opens breech.

1st powderman withdraws powder.

1st shellman withdraws shell. (It may be necessary to ram the shell out from the muzzle with a boom.)

(f) *Secure!*—The members of the crew, under the supervision of the gun captain, return everything that has been provided and secure the gun. If the gun has actually been fired, the crew will assist the gunner's mate in washing out and oiling the bore. Crew fall in for muster.

453. Drill of 5-inch 51-caliber R. F. gun.—

(1) *Titles and stations of gun crew.*—

TITLE.	STATION.
Plugman (gun captain) ..	At operating lever.
Pointer	At elevating wheel.
Trainer	At training wheel.
Sight-setter	At sight mechanism.
1st shellman.....	Left and rear of breech.
2d shellman.....	To pass shell to 1st shellman.
1st powderman.....	Left and rear of breech.
2d powderman.....	Right and rear of breech.
3d powderman.....	Pass powder to 1st powderman.

NOTE.—More shellmen and powdermen may be required if the ammunition supply is difficult.

(2) *Commands.*—

(a) *Stations!*—The gun crew go to their stations preparatory to loading and firing the gun.

(b) *Load!*—(The gun having been fired.)

Pointer and trainer keep gun on target.

Sight-setter sets sights as ordered.

Plugman opens breech; sees cotter pin in place; feels face of plug to see firing pin housed.

1st shellman puts in shell and attempts to seat it by giving it a quick shove; gets another shell from 2d shellman.

1st powderman puts in brass case and gets another one from 3d powderman.

Plugman closes breech and calls out "Ready!"

2d powderman stands by to catch empty case when gun is fired.

Other shellmen and powdermen provide shell and powder to 1st shellman and 1st powderman.

(c) *Commence firing!*—This command may be given either before or after the gun is loaded. If given before, the gun will be loaded at once. The firing and service of the gun are

started, the pointer firing on the firing signal, or when on the target depending upon the nature of the practice being held. The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted, or until the command "Cease Firing!"

(d) *Cease firing!*—[See I 2860 (4).] The service of the gun is stopped. If the gun is loaded, the plugman opens breech; 2d powderman withdraws brass case.

(e) *Unload!*—[See I 2858 (2) and I 2860 (1).] This command may be given after the command "Cease Firing!" in which case only the shell has to be removed, or it may be given after the gun is loaded and before the command "Commence Firing!" In the latter case—

Plugman opens breech.

2d powderman withdraws brass case.

1st shellman withdraws shell. (It may be necessary to ram the shell out from the muzzle.)

(f) *Secure!*—The members of the crew, under the supervision of the gun captain, return everything that has been provided and secure the gun. If the gun has actually been fired, the crew will assist the gunner's mate in washing out and oiling the bore. Crew fall in for muster.

454. Drill of 5-inch 50-caliber B. L. R.—

(1) *Titles and stations of gun crew.*—

TITLE.	STATION.
Plugman (gun captain) ..	At operating lever.
Pointer	At elevating wheel.
Trainer	At training wheel.
Sight-setter	At sight mechanism.
1st shellman.....	Left and rear of breech.
2d shellman.....	Rear of 1st shellman.
1st powderman.....	Directly in rear of breech.
2d powderman.....	Rear of 1st powderman.
3d powderman.....	At powder tanks.

NOTE.—Some officers prefer an extra man as primerman. This leaves the plugman free to wipe off mushroom head and watch the loading. This is the only type of B. L. R. gun that is loaded without the use of a tray or rammer. This can be done owing to the comparative lightness of the shell. More shellmen and powdermen may be required if the ammunition supply is difficult.

(2) *Commands.*—

(a) *Stations!*—At this command the crew go at once to their stations preparatory to loading and firing the gun.

(b) *Load!*—(The gun having been fired.)

Pointer and trainer keep gun on target.

Sight-setter sets sights as ordered.

Plugman opens breech; wipes off mushroom head; inserts primer.

1st shellman calls "Bore Clear!" inserts shell; shuts off air valve; gets another shell from 2d shellman.

1st powderman enters charge of powder, and rams shell home with it; gets another charge from 2d powderman.

Other shellmen and powdermen provide shell and powder to 1st shellman and 1st powderman, respectively.

NOTE.—Some officers prefer to have 1st and 2d shellmen alternate in loading shell in the gun. This is not considered good practice and tends to confusion and unnecessary movement. It is better to have 1st shellman load all shells in the gun and to have 2d shellman keep him supplied therewith as given in the above drill.

(c) *Commence firing!*—This command may be given either before or after the gun is loaded. If it is given before, the gun will be loaded at once. The firing and service of the gun are started, the pointer firing on the firing signal, or when on the target, depending upon the nature of the practice being conducted. The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted, or until the command "Cease Firing!"

(d) *Cease firing!*—[See I 2860 (4) and par. 8 (d) of Gen. Order No. 185 of May 11, 1912.] The service of the gun is stopped. If the gun is loaded, plugman rotates plug far enough to break the firing circuit, and then extracts primer.

(e) *Unload!*—[See I 2858 (2) and I 2860 (1).]

Plugman opens breech.

1st powderman withdraws powder.

1st shellman withdraws shell. (It may be necessary to ram shell out from the muzzle.)

(f) *Secure!*—The members of the crew, under the supervision of the gun captain, return everything that has been provided and secure the gun. If the gun has actually been fired, the crew will assist the gunner's mate in washing out and oiling the bore. The crew fall in for muster.

455 Drill of 4-inch 50-caliber R. F. gun.—

(1) *Titles and stations of gun crew.*—

TITLE.	STATION.
Plugman (gun captain) ..	At operating lever.
Pointer	At elevating wheel.
Trainer	At training wheel.
Sight-setter	At sight mechanism.
1st shellman	Left and rear of breech.
2d shellman	} Rear of 1st shellman.
3d shellman	
4th shellman	Right and rear of breech.

NOTE.—More shellmen may be required if the ammunition supply is difficult.

(2) *Commands.*—

(a) *Stations!*—At this command the crew go to their stations preparatory to loading and firing the gun.

(b) *Load!*—(The gun having been fired.)

Pointer and trainer keep gun on target.

Sight-setter sets sights as ordered over fire control system.

Plugman opens breech and feels face of plug to see if firing pin is housed.

1st shellman inserts and shoves home the cartridge case.

Plugman closes breech and calls out "Ready!"

2d and 3d shellmen provide ammunition to 1st shellman.

4th shellman stands by to remove empty case after gun is fired.

(c) *Commence firing!*—This command may be given either before or after the gun is loaded. If it is given before, the gun will be loaded at once. The firing and service of the gun are started, the pointer firing on the firing signal, or when on the target, depending upon the nature of the practice being conducted. The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted or until the command "Cease Firing!"

(d) *Cease firing!*—[See I 2860 (4).]

The service of the gun is stopped.

If the gun is loaded, the plugman opens breech.

1st shellman withdraws loaded cartridge case.

(e) *Unload!*—[See I 2858 (2) and I 2860 (1).] This command will be given only after the gun is loaded and before the command "Commence Firing!" Procedure is the same as at "Cease Firing!"

(f) *Secure!*—The members of the crew, under the supervision of the gun captain, return everything that has been provided and secure the gun. If the gun has actually been fired, the crew assist the gunner's mate in washing out and oiling the bore. The crew fall in for muster.

456. Drill of 3-inch 50-caliber semi-automatic gun.—

(1) *Titles and stations of gun crew.*—

TITLE.	STATION.
Plugman (gun captain) ..	Near operating lever.
Pointer	At elevating wheel.
Trainer	At training wheel.
Sight-setter	At sight mechanism.
1st shellman.....	Left and rear of breech.
2d shellman.....	Rear of 1st shellman.
3d shellman.....	Directly in rear of breech.

NOTE.—More shellmen may be required if the ammunition supply is difficult.

(2) *Commands.*—

(a) *Stations!*—At this command the crew go to their stations preparatory to loading and firing the gun.

(b) *Load!*—(The gun having been fired.)

Pointer and trainer keep gun on the target.

Sight-setter sets sights as ordered.

Plugman (gun captain) supervises.

1st shellman loads and shoves home the cartridge case.

2d shellman provides another case to 1st shellman.

3d shellman stands by to catch the empty case when the gun is fired. If it does not come clear out he extracts it.

NOTE.—The plugman has re-cocking tool in one hand and stands by to re-cock in case of mis-fire. Aside from this, his duties are supervisory only unless the plug does not remain open after the gun is fired. In this case, he, of course, opens the plug. If the semi-automatic attachment is not being used, the plugman opens and closes the plug for each shot.

(c) *Commence firing!*—This command may be given either before or after the gun is loaded. If it is given before, the gun will be loaded at once. The firing and service of the gun are started, the pointer firing on the firing signal, or when on the target, depending upon the nature of the practice being conducted. The gun is reloaded as soon as fired, and firing continues until the ammunition is exhausted, or until the command "Cease Firing!"

(d) *Cease firing!*—[See I 2860 (4).]

The service of the gun is stopped.

If the gun is loaded, the plugman opens breech.

1st shellman withdraws loaded cartridge case.

(e) *Unload!*—[See I 2858 (2) and I 2860 (1).] This command will only be given after the gun is loaded and before the command "Commence Firing!" Procedure is the same as at "Cease Firing!"

(f) *Secure!*—The members of the crew, under the supervision of the gun captain, return everything that has been provided and secure the gun. If the gun has actually been fired, the crew assist the gunner's mate in washing out and oiling the bore. The crew fall in for muster.

PART V

ORDNANCE, AMMUNITION AND EXPLOSIVES

	PAGE
CARE AND PRESERVATION OF ORDNANCE OUTFIT...	81
NOTES ON AMMUNITION.....	104
NAVY SMOKELESS POWDER.....	112
PRESERVATION AND TESTS OF POWDER.....	122
CARE AND HANDLING OF TORPEDOES.....	133
GUN COTTON AND TRINITROTOLUOL.....	147
DEMOLITIONS	157

ORDNANCE, AMMUNITION AND EXPLOSIVES.

NOTE.—Prepared in the Bureau of Ordnance, Navy Department.

CARE AND PRESERVATION OF ORDNANCE OUTFIT.

501. General routine and cleaning.—

(1) *Routine*.—In order to prevent deterioration, the following routine is prescribed for the gunnery department of a vessel in commission:

(a) Every part of the battery shall be moved, and all turret equipment, including turret turning gear, tested daily, except on Sundays and holidays, and when coaling ship or heavy weather interferes. Torpedo tubes, air compressors and gas ejectors shall be manipulated once a week; and all guns, if not fired, shall be run in once each year.

(b) The bores of guns shall be kept thoroughly clean and coated with oil. They shall be examined frequently, and the coating renewed whenever necessary.

(c) All bright steel work in the turrets, including the sword, sword box, arc plates, pivots, etc., of the sights shall be kept lightly coated with vaseline or oil.

(d) Before testing any apparatus, the oil cups and grease cups shall be examined to see that the bearings get sufficient lubrication.

(e) All the ammunition hoists shall be tested weekly without load, five minutes hoist and five minutes lower.

(f) The bores of the guns of the torpedo defense battery shall be treated in the same manner as the turret guns; and the frictionless bearings, sword, sword box, etc., shall be vaselined and covered with a piece of muslin.

(g) The breach mechanism shall be vaselined and kept in place, and the muzzle closed with tampion and bag.

(2) *Cleaning*.—As the satisfactory performance of mechanical gun carriages, breech loading rifles, rapid fire and machine guns depends in a great measure upon the condition in which they are kept, it is directed that the greatest care and attention be given to keep all parts clean, properly lubricated and in thoroughly good working order.

(a) All breech mechanisms must be cleaned daily, avoiding the use of any gritty substance. The breech plug must be frequently removed from the tray, in order that the bottom threads may be reached for cleaning.

(b) Brick dust or gritty substances must never be used on any part of the gun.

(c) The parts of the mechanism must never be scraped with knives or metal scrapers, or be defaced or roughened in any way.

(d) All bare metal parts of the gun and mount must be kept lightly oiled as a protection against rust.

(e) Particular attention should be given to keeping the slope and the origin of rifling well oiled and free from rust.

(f) After firing guns of 6-inch caliber and below, completely dismount the breech mechanism and wash every part with warm fresh water and soap; dry carefully, then rub all parts with a well oiled rag, and assemble the mechanism.

(g) Keep rapid fire and machine guns covered whenever there is a chance of getting coal dust, grit or salt water on them. Inspect and re-oil the guns once a week. In re-oiling first wipe off all the old oil, which may have become clogged with dust and grit.

(h) If the guns are closed by tompions, these should be withdrawn every fair day, and the compression slopes cleaned and re-oiled.

(i) All axles, such as those of trucks, elevating and training gear, yoke and pivot bolts, elevating arc bolts, etc., are to be taken out, cleaned and oiled once in two months, or oftener if circumstances render it necessary.

(j) The ball bearings and friction rollers of R. F. mounts should be kept clean and lightly oiled, in order to prevent rusting. The oil channels in the slide of a R. F. mount must be kept clear of dirt, and should be filled with oil before the gun is fired.

(3) *Gas checks.*—The gas checks should be protected as far as possible from the weather, and from everything which could indent or bruise the pads. The rings or discs should be kept scrupulously clean and well oiled, and the pads should be habitually coated with tallow. After firing a gun the mushroom and gas check should be removed, cleaned and oiled as soon as practicable. The pads, rings and discs should, when practicable, and especially after bad weather at sea, be removed, cleaned, dried and oiled.

(4) *Painting.*—Guns are not to be painted in rear of slide over that portion passed by the strengthening band in firing, as in the case of the 4-inch and 5-inch guns. The roller paths must be oiled once a week, and the top carriage raised and rollers taken out and cleaned at least once a quarter. Oil holes must be kept clear and closed in wet weather. Training and elevating gear must be kept clean, and all steel parts well oiled. For this purpose they must be removed at least once a month.

(5) *Friction discs of intermediate battery guns.*—Friction discs should be kept clean and perfectly free from oil or other

lubricant. Washing in lye water and then thoroughly rinsing in fresh water will remove all oil and grease. In discs of the multiple type it has been found that one man, using a 24-inch wrench, can set them up sufficiently hard.

(6) *Material for cleaning lenses.*—For all guns using telescopic sights suitable material for wiping the lenses will be obtained from the gunner's mate or turret captain. No other than the specially provided material will be used for wiping lenses; and lenses will be wiped, even with this special material, only when absolutely necessary. (Lens paper is now supplied.)

(7) *Difficulty in opening the breech and in cleaning or training guns.*—This is frequently caused by burrs on the diagonal teeth of the breech plug, or on the worm gearing of the elevating or training mechanism. Undue difficulty of elevating or training any of the more recent gun mounts is due to some defect in the individual mount itself and not in the design. Frequently this difficulty is caused by a shaft being slightly bent or out of alignment, and can usually be discovered if searched for progressively.

502. Turrets.—

(1) *General care.*—All parts of the turret, turret machinery and gun fittings should be kept clean and free from rust.

(a) All working parts should be kept well lubricated. No fresh lubricant should be applied to any part without first removing the old coating and thoroughly cleaning the part. In case the coating is difficult to remove, it should be rubbed away with a rag saturated with kerosene. The use of scrapers is prohibited.

(b) Operating levers, valves, valve stems, rollers, roller path, ammunition hoist guides, ammunition cars, rests, handling room truck and turn table shell room trolleys and rails should be kept free and clean from paint, and should be occasionally wiped with an oily rag to prevent rusting. These parts should not, however, be considered as bright work.

(2) *Painting.*—The inside of the turret, including the sides, the top and those platforms not ordinarily trod upon by the crew should be painted white—preferably with white gloss paint—in order to give as much light as possible. No colored paint should be allowed except that the slits in the sighting hoods should be painted a medium shade of green, as should also a section of the turret roof in front of each telescope. The guns may either be painted white or they may be kept bright and burnished. Tools, racks and rails should be kept bright. After they are once put in condition they are easily maintained. If they are not prevented, the men in the turret will try to paint a little more, from time to time, until everything is covered. Either asphaltum, varnish or brown zinc with plenty of drier in

it is a good coating for turret platforms and floors, where oil and water are likely to drip.

(3) *The wire fall of the ammunition hoist.*—This should be kept clean, with a slight coating of oil or graphite and tallow, to preserve it. As the wire rope stretches, the slack must be taken up and the hoist tested to see that the automatic "cut-off" stops the motor before the car can strike the block at the turret roof. It is also necessary to remove slack from a stretched wire rope to avoid getting kinks in it. A stranded or badly rusted wire rope should be immediately replaced.

(4) *Plug crank.*—The plug crank should be left shipped for all ordinary firing. If firing at extreme elevation it may, in some turrets, be necessary to unship it before firing the gun.

(5) *Closing breech.*—Occasionally when the breech plug is closed with too much force the rear end of the plug is lifted slightly in the screw box by the spiral pinion, so that the axis of the plug is not in line with the axis of the bore. Consequently, the teeth of the unlocking rack will bear too hard on the spiral pinion, and they are liable to injury when the gun is fired. (This accident occurred on several ships during the bombardment at Santiago de Cuba.) To avoid this, ease back slightly on the operating crank after the plug is entirely closed, and if the plug has been lifted out of line it will be seen to drop down into its proper place. Then close gently to insure proper contact of firing circuit.

(6) *Use of power.*—When a ship first goes into commission a great deal too much power will be required to run the gear, and in electric turrets circuit breakers will give trouble by frequently blowing. If the gear is run each morning and used every day for Morris tube practice, the trouble will gradually decrease.

(7) *Gear in turrets.*—While it is particularly desirable that no unnecessary gear be allowed in the turret or beneath it in the handling room, yet some tools are necessary so that too many trips may not have to be made to the ordnance storeroom. A small vise securely mounted in the turret is almost a necessity and, besides this, various other tools, spare parts and material are necessary. All of this material should be stowed in metal boxes and, as far as practicable, under the floor plating or in such places that a large shell striking the turret or a small shell exploding inside of it would not be likely to displace them. All wrenches, etc., belonging to the turret should be so secured that a severe shock may not send them flying about. No articles should be secured to the walls of the turret.

(8) *Log.*—A smooth log should be kept by the turret officer which should show that the gear has been run each day, what repairs have been made, the general work done and the condition of the turret and mechanism. It should also contain a record of target practice and the names of the men under

instruction for pointers, gunner's mates, hoistmen, etc. In fact, anything of interest. Every turret officer who has kept a turret log has found it very useful.

(9) *Seating shell.*—Owing to the angle of elevation at which the old types of guns are loaded, the projectile sometimes starts back from its seat after being properly set home. This is very easily and efficaciously remedied by means of two turns of a rope yarn or other small stuff around the projectile just forward of the compression band. The sound will always tell the officer whether or not the shell is home. With mounts using electric chain rammers, or hand rammers, a mark may be placed on the last section of the rammer to indicate when the shell is home.

(10) *Turret locks.*—During heavy weather at sea, watch the turret and keep the locks set well home to prevent any motion. Do not attempt to enter the turret locks when the turret is moving.

(11) *Turret turning.*—(a) Before turning a turret, ease up on the holding-down springs of the water shed, or raise the water shed if practicable; see everything clear outside of and in wake of the guns and see everything clear in the handling room.

(b) The rollers and roller paths should be examined once a week by the turret officer, who should assure himself of their cleanliness and freedom from rust; and before turning the turret he should ascertain if the roller path is free of obstructions. The men should be cautioned not to leave tools, cleaning rags or other implements on the roller path. Much depends upon keeping the rollers and roller paths smooth and clean. A light coating of oil will insure against rust. The training racks should be kept free from rust and be well coated with Albany grease or vaseline.

(c) Any defect in the working of the turret motors should be promptly reported to the gunnery officer. If one turning engine or motor is disabled it should be shut off, as the other one will suffice to train the turret at a moderate speed, unless the ship is very much heeled.

503. *Loading and unloading.*—

(1) *Loading.*—

(a) All turrets should be supplied with gear for loading by hand.

(b) During hostilities it may be necessary to keep the guns loaded in anticipation of an immediate attack. In such cases, while awaiting the attack, the electric contact at the breech plug should be kept broken.

(2) *Unloading.*—

(a) When an attack is considered no longer imminent, the gun should be unloaded and the powder returned to the magazine; the shell may be left in the car, if desirable. If the

shell cannot be easily withdrawn it may be left in the bore for a few days if there is a probability of it being required during that period of time. In this case a wooden batten, equaling in length the distance between the base of the shell and the mushroom head, should be placed in the powder chamber to prevent the shell working to the rear against the plug.

(b) In loading, especial care shall be taken not to injure the gas check slope of the gun. If the slope be injured, the escape of gas to the rear cannot be prevented, and serious damage may result.

(3) *Powder charge*.—Powder charges should never be kept in the turret or in the ammunition car, as the change in temperature of that charge would probably insure a miss with that shot, and besides would render its value as a trial shot worthless and misleading. For the above reasons, if in anticipation of an immediate attack the gun has been completely loaded for fifteen or twenty minutes, and the attack is still imminent, the charge should be withdrawn and a new charge fresh from the magazine should be loaded.

(4) *Choke*.—Care shall be taken to see that the choke of guns is not so great as to overcome the clearance between the bore and the bourrelet diameter of the shell. This clearance should never be less than one-hundredth of an inch.

(5) *Seating*.—Every gun shall have the distance from the face of the tube to the base of the seated projectile measured frequently. If, on account of erosion, shells seat at different distances in different guns of the same kind, allowance for this fact should be made in order to eliminate dispersion of fire.

(6) *Primer seat*.—In every powder bag gun care shall be taken to keep the primer seat thoroughly clean and smooth. If the primer seat does not permit close fitting of the primer, primer blowbacks may occur, possibly disabling the firing mechanism. Frequent use of the taper reamer with the entailed wear of the primer seat is to be avoided.

(7) *Firing mechanism*.—Every effort shall be made to keep the firing mechanism of every cartridge case gun in thoroughly efficient condition. A defect in the firing mechanism may cause the gun to be fired prematurely.

504. Gas checks.—

(1) *Spare*s.—With each powder bag gun there are issued spare gas check pads and spare gas check rings. These pads and rings are carefully fitted to the guns and are not likely to give any serious trouble.

(2) *Adjusting*.—In fitting a new set of gas check rings or gas check pads they should be very carefully adjusted. The bearing of the rings and pad in the gas check seat should be verified by making chalk marks, parallel to the axis of the bore,

in the gas check seat; closing the breech, then opening it and noting the marks transferred to rings and pad.

(3) *Life*.—The life of a pad is variable. The gas check pad and rings should be protected from the weather and everything that could indent or bruise them. The rings and gas check seat should be kept scrupulously clean and well oiled, using soft rags or pieces of waste. Neither the rings nor gas check seat should be cleaned with any gritty substance, nor should they ever be touched with a file or emery cloth, except in extreme cases to remove a burr or score, which must always be done in the presence of an officer; as, to insure proper checking, these rings must be a most accurate fit. The pad should be habitually coated with tallow and, after firing, the mushroom and gas check should be dismounted, cleaned and oiled as soon as possible.

(4) *Injuries*.—(a) As the pad is liable to be injured in spite of all precautions, it becomes important to know how serious such injuries are. The pad will perform its function in spite of almost any amount of bruising, if its circumference is intact, even though it has lost a portion of its filling. An exception may be found to this statement in cold weather, when, by the hardening of the pad, its plasticity is much reduced. An injured pad should be replaced, however, if time permits.

(b) With the latest form of gas check, the nuts on the mushroom stem should be set up moderately tight and left so. There is very little chance of the pad or rings sticking.

(c) If necessary to fire with a defective pad, give the circumference of the pad a thick coating of tallow before firing. If, after firing, a pad is found to be scored or burned, the front gas check ring is not functioning properly and should be carefully examined for fit and for scoring and, if defective, replaced with a perfect one.

(d) During practice the pad and mushroom head should be frequently sponged off with fresh water.

(5) *Hardening*.—If a pad becomes very hard, soak it in a hot mixture of oil and tallow.

(6) *Cover slack*.—If the canvas covering of a pad appears to be slack at any time, the pad should be rejected.

(7) *Inspection*.—The inspection of the gas check by the plug-man is to see that the rings and pad are properly adjusted and that the nuts on the mushroom are set at proper tension. Care should be taken that the pad and rings have not dropped down, and as may be the case if the nuts on the mushroom stem are not set up tight enough. The adjustment is correct if the plug-man can just turn the mushroom head, using both hands, and if the pad is smooth and intact all around, the rings being flush with it and the plug proper.

(8) *Shifting*.—It is well to always have at hand a net strap

which fits snugly over the mushroom head to use when shifting the gas check pads. At high temperature the gas check pads become soft and sometimes disintegrate after several rounds. The mushroom will be too hot to touch with the hands when shifting pads, and therefore the necessity for a strap fitted with a net to go over the mushroom head, and also for a small tackle to take the weight. A gas check pad can be shifted very quickly even with a hot breech plug. During action it is not necessary to shift a gas check pad at the first sign of disintegration, as it will check the gas for a number of rounds after the rear wall of the turret has been spattered with asbestos and tallow, but continue to set up on the adjusting nuts of the mushroom stem after each shot and shift the pad at the first opportunity. It must be borne in mind, however, that if too much of the pad be lost there is danger of bending the gas check rings or discs.

(9) *Manufacture of gas check pads.*—(a) The pad is composed of an obturator cake, made of sixty-five parts of asbestos and thirty-five parts of pure mutton tallow, contained in a linen canvas cover. The tallow is made from kidneys, tried out in pure water on a slow fire, skimming off impurities and then straining through a muslin cloth. This operation is repeated. In making the cake the asbestos is pulverized, and the proper proportion of it and the tallow having been weighed out, the tallow is placed in a shallow pan and heated over steam or a slow fire. The asbestos is slowly added and thoroughly mixed with a wooden spatula, and then the cake is allowed to cool. Its color is almost a dark gray. The proper amount of the mixture for the particular sized pad is now weighed out and rounded to the proper shape with a hydraulic press called the mould. The moulding apparatus consists of the mould, the former and the follower. The diameter of the mould's bore is that of the finished pad plus one-hundredth inch clearance. The upper part of the former's flange and the spindle exactly reproduce the front gas check ring, shank and fillet. The follower is a plunger recessed to go over the stem of the former and neatly fits the mould. The former being in place, a little powdered asbestos is sprinkled on the bottom, and then the warm cake mixture is put in and patted down equally all around. The rear gas check ring is then placed over the mixture and the follower lowered down on top of the disc, and the whole apparatus put on the table of the hydraulic press and subjected to pressure for fifteen minutes to half an hour until cool. The cake being moulded and its canvas cover placed on one side, with corners hauled over the opposite side and edges caught by stitches, is brought back to the press and subjected to a high pressure. The pad is then taken out and sewed on the other side, brought back, again placed in the mould and subjected to pressure when the pad is complete and ready for service.

(b) The canvas cover is made in two parts, being cut on the bias, so that the stitch will be more uniform and less apt to pucker while sewing. The cover is made on a wooden disc the exact shape of the moulded cake. The ends of the long piece are sewed together, hauled over the disc, carefully centered and held by a few tacks driven in the rim of the disc. The points on one side are pulled tightly down and tacked. The short piece (ends having been sewed together) is placed in the hole of the disc and a wooden plug tapered like the mushroom shank fillet is driven in. The points of one side are brought down over those of the outer piece, held by tacks and then the lapped edges sewed. The tacks are then removed and the cover is ready to receive the moulded cake for first pressure.

505. Care of Farcot breech mechanism.—

(1) *Alignment*.—The greatest amount of trouble with the Farcot breech mechanisms seems to be caused by the plug tray getting out of alignment, thereby causing the gears to cut and burr, shafts to bend and the plug to jam.

(2) *Latch*.—In some designs of Farcot mechanisms the tray latch catch, in addition to its regular function, has to resist and overcome the momentum of the swinging plug. This may result in the latch burring or cutting into the engaged thread of the breech plug and cause jams. The latest designs have a stop on the tray for the purpose of taking the thrust of the plug.

(3) *Tray*.—(a) In withdrawing the plug, a large part of the applied power becomes downward thrust, which is taken up largely by the upper surface of the combination pinion working against the withdrawing rack slot in the plug. The metal of the breech block is fairly soft, so that the downward thrust forces the upper surface of the slot for withdrawing rack hard against the upper surface of the combination pinion. There is a tendency to wear away the upper side of the slot to such an extent that when power is applied the downward thrust (since the outboard side of the plug is only partly supported by the upper surface of the combination pinion) tends to force the plug downward with such force compared to the withdrawing component that the plug bites hard on the outboard slide of the plug tray and in a short time the soft metal of the tray becomes scored, making it difficult to work the plug.

(b) If this wear is serious enough, it may be necessary to fit in a piece of steel to bring the slot to its original size.

(c) While the constant working of the tray hinge on the bearing on the hinge plate and around the hinge pin will undoubtedly cause the surface to wear, thereby throwing the tray out of alignment to some extent, it is believed that the cause of most of the trouble is the sliding of the heavy steel plug back and forth on steel slide surfaces where little or no lubrication has been applied. This practice must sooner or later cause galling,

and even burrs to form, which, if occurring in the screw box, brings undue strain on gears and shafting, causing the cutting and bending above referred to. Should the galling and burring of the sliding surface appear on the tray a heavy strain is brought on the tray, and it may even be so great as to cause twisting and bending.

(d) Every effort should be made to see that the plug trays are in proper alignment both during drill and during the firing. Care should be taken to see that plugs are not left on tray unnecessarily long, and especially that the gun is not rapidly elevated or depressed while the plugs are resting on the tray. To be assured that the plug trays are in proper alignment the following instructions should be carefully followed:

(4) *To check alignment.*—(a) Remove the plug and swing the tray up against the breech face of the gun in the closed position. With a straight edge see that the side bearing on the tray next to the hinge is parallel with the bore of the gun. See that the bottom bearing surface is in line with bearing surface in screw box, and note that the side bearing on tray farthest from hinge is slightly higher than bearing on the plug in order to allow for sag when the weight of the plug comes on the tray. The front end of this slide is slightly beveled to allow the plug to slide on the tray.

(b) If it is found that the bearings on the tray are lower than the bearing surface in screw box, take off that amount of metal from the upper part of the hinge and add a washer of that thickness to the bottom part. This will raise the tray to the proper height.

(c) Should the outer section of the tray have a permanent droop, this may be taken out and that part of the tray raised by peening up on the under side from the center up toward the edge that is to be raised.

(d) All bearings should be gone over to see that shafts are in proper alignment and that all gears mesh properly.

(e) All bearing surfaces and the teeth on all gears and rotating rack should be gone over and burrs and rough metal removed.

(f) After this is done all parts should be carefully lubricated with castor oil and kept so lubricated.

(5) *Lubrication.*—Every attention should be given to see that all parts of mechanism are thoroughly lubricated, both during firing and on drill. It is especially important that the upper surface of combination pinion and the slides on plug tray be kept heavily lubricated. Experiments with different lubricants show that castor oil is excellent, vaseline and graphite very good and white lead and tallow good. Castor oil need be applied only in very thin coats, with a flat brush, and it is believed that one application should be sufficient for four or five

rounds. It will also be found that the use of castor oil will greatly add to the ease with which the mechanism may be worked, and the speed of operation thereby increased.

(6) *Keep screws.*—Keep screws should be put in all bolts for hinge plates and other parts of mechanism, so as to prevent the bolts slacking back.

506. Miscellaneous instructions.—

(1) *Ordnance pamphlets.*—The methods of caring for and handling ordnance material set forth in the descriptive pamphlets issued by the Bureau of Ordnance shall be closely followed.

(2) *Before firing.*—Before firing, carefully clear all oil out of powder chamber and from mushroom head.

(3) *After firing.*—After firing, wash the gun out with the washing hose and bristle bore sponge; then wash the bore thoroughly with fresh water and after it is dry give it a good coat of oil. The guns should be sponged and oiled once a week. Fit the bore sponge with two lanyards for hauling it through the gun; cover it with a piece of old blanket and haul it back and forth until the bore is clean and dry; then wrap a piece of well oiled blanket around a sponge cylinder and haul it through to oil the bore.

(4) *Material.*—The use of emery cloth, brick dust or similar polishing material should be forbidden on the following named parts of the mounts:

Interior of valve casings,	Hardened plate on spring bar
Piston valves,	of knife edge trunnion bearing,
Valve faces,	
Adjusting screws,	Telescope sights,
Elevating worm,	Telescope sighting mechanism,
Elevating worm wheel,	Screw thread on elevating rod,
Elevating pinions,	Piston rods,
Knife edges,	Rammer sections,
	Sight adjuster.

(5) *Air compressor.*—(a) In starting an air compressor it shall be run slowly until it becomes warm and until there is a pressure of at least 25 pounds in the accumulator to provide an air cushion. To avoid overheating of the air cylinder, compressors of the Westinghouse or similar type, not fitted with water jackets, shall not be run at too high rate of speed, and care shall be taken that the governor acts properly.

(b) After using air compressing machinery for any purpose great care shall be taken to see that the engines, pumps, separators, charging columns and reservoirs are blown out and thoroughly drained of water. The pressure gauges shall be left open to the spaces to which they are attached, so that any pressure that might remain in the system will be indicated in order to avoid accidents upon disconnecting parts.

(c) A spare set of leather cup washers shall always be ready for use, such leathers being kept in tins filled with neat's foot, castor or other oil suitable for keeping them soft and in proper condition.

(d) The oil used for lubricating the internal parts of the air cylinders when the packings are of leather shall be neat's foot; or, if that is not obtainable, castor oil or other suitable oil shall be used. Such oil, however, shall not be allowed to enter any steam cylinder.

(e) The testing of air compressors by charging torpedo air flasks at the full speed and capacity of the compressor is prohibited.

(6) *Modifications.*—Material changes or modifications in the batteries of ships or any of their attachments, or in the torpedo equipment, shall not be made without the explicit authority of the Bureau of Ordnance, as this Bureau has the ultimate responsibility for the efficiency of armaments of ships, and it can meet this responsibility satisfactorily only when suggestions and recommendations for changes are referred to it for decision.

507. Accessories and spare parts.—

(1) *Allowance lists.*—A list of all accessories and spare parts allowed the vessel and which are supplied upon commissioning are included in the ship's allowance list furnished by the Bureau of Ordnance. The gunnery officer, division officers, turret captains, gunner's mates and gun captains should be made familiar with the uses and amount of all gear included therein and be instructed as to where it is stowed.

(2) *Spare parts.*—These are supplied to ships not only for the minor portions of the breech mechanism, sights, etc., but for nearly every principal part of the gun mount. At clear ship for action these spare parts should be placed in a previously designated position, convenient to the battery, but so removed as to be no source of danger to the personnel. The shifting of these parts should be included in the instruction of the gun crews, and they should be drilled until proficient in rapidly replacing all parts that may be damaged in action.

(3) *Replacing.*—Means should always be at hand at general quarters for promptly shifting every part of the sight, breech mechanism and gun mount, but unless the spare parts are permanently stowed near the guns they should be obtained as needed from the storeroom and returned upon completion of drill. It is preferable, however, to arrange such spare parts permanently in brackets on bulkheads, convenient to but removed from the guns. In this case they do not have to be specially provided at clear ship for action. In turret guns these heavy spare parts should be kept permanently in brackets on bulkheads in the handling rooms and turret structure, so that they will be immediately available as needed.

508. Saluting instructions.—

(1) The characteristics of a saluting vessel are laid down in R 1201-1213.

(2) No salute will be fired with less than four guns (of the type used in saluting, except when less than four guns are carried), being cleared away ready for firing. Two of these guns will be on each side, and they should preferably be adjacent to each other. Two of these guns will be auxiliary and two (one on each side) used for the salute.

(3) The gunner of the ship, or the chief gunner's mate, will give the necessary commands for firing. Before commencing the salute he is to assure himself that the pointers of the guns about to be fired clearly understand the order of firing, and in giving the commands for firing he is to be within sight and easy hearing distance of the gun. He will regulate the time interval and count the guns.

(4) The guns employed should be manned either by the gunner's crew or by the gun crews or by a crew of a similar gun, so that there may be no want of acquaintance with the drill.

(5) Specially selected men should be stationed at the stand-by guns to fire in case the regular gun on that side misses fire. The stand-by guns will be loaded but breech plug left open, and the men stationed at them will each closely watch the saluting gun on his own side, and the instant he perceives a mis-fire from the regular gun he will close the breech and be ready to fire when ordered by the saluting officer.

(6) In ships in which a choice is possible such guns are to be chosen as facilitate the above instructions being carried out.

(7) The procedure in firing a salute will be as follows:

(a) The guns will be cast loose and prepared for firing at the call "Saluting gun crews to quarters."

(b) When ready, the officer firing the salute will command **LOAD!** at which the two saluting guns will load. The stand-by guns will load, leaving the plugs open, and the designated men will take stations at these guns.

(c) The guns will fire in succession, first starboard, then port, by order of the command. The interval between shots shall be five seconds.

(d) After firing, each gun will reload and stand by to fire at the command.

(e) On completing the required number of "guns," the command will be given **CEASE FIRING! UNLOAD!** and report will be made to the officer of the deck that so many "guns" have been fired.

(f) The officer of the deck shall always sound **ATTENTION!** before firing the salute, and **CARRY ON!** after it is completed.

(8) When using small R. F. guns, in case of a mis-fire the breech will not be opened for thirty minutes. If the gun can be

recocked, the crew of the regular gun will recock it, and it will be tried on the next shot fired from that side, the auxiliary gun standing by as before. If it again fails to fire, it is thrown out of the salute.

(9) Powder removed from the magazines for saluting shall not remain out over night. During the day it must be kept in tanks, with the lids screwed down, and in charge of a sentry or other responsible person.

509. Recoil cylinders, liquid and care.—

(1) *Liquid*.—(a) The mixture used in the recoil cylinders consists of glycerine, eighty parts by measure, and water, twenty parts by measure. The glycerine used should be free from fatty acids, and the following tests are prescribed:

(b) Add to a sample of the glycerine in a large test tube about equal bulk of a saturated solution of slaked lime and thoroughly shake the two together. If, after standing some time, a sediment is deposited, the glycerine contains fatty acid, and is unfit for use in recoil cylinders.

(c) Take another sample of the glycerine in a test tube and add about an equal bulk of a saturated solution of acetate of lead. If, after thoroughly mixing and standing for some minutes, a deposit appears, add acetic acid and heat the contents of the tube. If the deposit disappears, or if no deposit appears after the mixing with the acetate of lead, the glycerine is free from fatty acid and fit for use in the recoil cylinders.

(d) Both tests should be made, as one is the confirmation of the other.

(2) *Cleaning*.—The liquid in the recoil cylinders (glycerine 80 per centum, fresh water 20 per centum) becomes muddy after a time and the grooves of the cylinders may become clogged from a thick, pasty sediment, which is removed with considerable difficulty. It is therefore directed that the recoil cylinders be emptied, cleaned and refilled directly after the vessel is commissioned and at the end of each year thereafter, as much fresh liquid being added from time to time as may be necessary. The glycerine must be free from fatty acids and the water clear of alkalies and mineral salts; otherwise it will corrode the inside of the cylinders. When exposed to heat glycerine expands and, if for a long time, gums; and this causes filling in of grooves, checking the equalizing pipe and gumming of the counter recoil check, and any of these will cause a gun to function improperly and sometimes cause enough damage to disable a gun. Gummed glycerine may be removed with a strong lye or soda solution if not hard, but must be well cleaned out afterward with clean, fresh water. When in hot weather cylinders that have been filled in cold weather may weep—that is, leak around bonnets, filling plugs and stuffing boxes. This is caused by an internal pressure due to the expansion of the glycerine, and in some of

the lighter guns may fail to allow the gun to return to battery. This is remedied by taking out the filling or air vent plug and allowing the surplus liquid to escape, relieving the pressure.

(3) *Circulating pipe*.—The circulating pipe on carriages having two recoil cylinders must be carefully looked after to guard against clogging, and be thoroughly cleaned whenever the cylinders are emptied. Blow through the filling holes to see if the circulating pipe is clear.

(4) *Leaks*.—As recoil cylinders occasionally leak, even when they seem quite tight, especial attention will be directed to them during the daily inspection, in order to ascertain whether there is any perceptible leak. Loss of liquid, therefore, will be supplied at once. Before every firing, unless an emergency makes this impracticable, the recoil cylinders shall be invariably examined and filled.

510. Filling recoil cylinders.—

(1) *4-inch, 5-inch, 6-inch and 7-inch*.—(a) Depress the gun slightly; remove the filling plugs of each cylinder or the air plug hole of the opposite cylinder to the one into which the liquid is to be poured. Pour until the liquid runs out of the opposite cylinder.

NOTE.—If the filling plugs are in the front end of the cylinders, elevate the gun slightly; if in the rear, depress the gun slightly. When in any other position keep gun level.

(b) If there is no air hole, care must be taken to pour the liquid into the funnel in small quantities. Care also must be taken to measure the quantity of liquid poured into the cylinder and to strain it through a piece of bunting or cheese cloth to prevent entrance of dirt.

(2) *6-pdr., 3-pdr. and 1-pdr.*—All hydraulic recoil mounts for minor R. F. guns thus far issued to service (except 6-pdr. Mark III) have only one filling hole in the boss on the cylinder. The funnel is placed in this hole, and in all other respects the process of filling the cylinder is the same as previously described.

(3) *6-pdr. Mark III*.—(a) In mounts fitted with the Driggs-Schroeder gun the shoulder bar must first be removed.

(b) Keep gun level. Take out filling hole plug and side screw. Screw in filling funnel and pour slowly until liquid runs out of side screw hole. Replace both screws.

511. *Replacing piston rod packing*.—Take off piston rod nuts, elevate gun and let it recoil against its stops. When re-packed, depress gun and let it go out to battery. Set up on piston rod nuts as tightly as possible to bring shoulder of piston rod against oscillating slide. The shoulder inside of threaded part of piston rod must be drawn close against the inner face of the oscillating slide, so that the clearance between the rear face of piston and front face of the cylinder head shall be preserved. This clearance is from .10 inch to .15 inch, depending upon the thickness of leather packing on face of cylinder head.

512. Recoil cylinders; construction, faults and remedies.—

(1) *Cylinders*.—Those in the older type of mounts were cast in one with the slide, but in the later types are made separate and strapped to the slide.

(2) *Equalizing pipe*.—The equalizing pipe, in the earlier types, was cast in one with the cylinders, and is used to equalize the pressure in the cylinders on the recoil and counter recoil and is used in any cylinder mount that has more than one cylinder that contains liquid. In some of the modified slides the equalizing pipe can be cleaned from the outside, by a hole bored in line with it, and this is closed with a screw plug. In the latest types of slides this pipe is made entirely separate, and can be removed if necessary and can be cleaned by removing plugs that are at outside ends of the pipe; these are used as drain plugs where so fitted.

(3) *Bonnets*.—These are the movable parts used to close the cylinders at both ends. They are usually threaded on their outer edges and screw into a corresponding thread in the inner ends of the cylinder, but in the heavier types, commencing with the 8-inch, they are held in by bolts. Between the bonnet and the end of the cylinder is placed a leather washer that has been oil treated; this is to make the joint tight. The bonnet through which the piston rod passes contains a stuffing box, and in the 3-inch and above some part of the counter recoil check. (The above refers to cylinders that contain liquid.)

(4) *Pistons and rods*.—These are usually made in one piece, but in some mounts they are made separate and screwed together or held together with nuts. They pass out of the cylinder and secure to the transom of the earlier types and to the yoke in the later types, usually secured with two nuts, one being larger than the other; the larger nut is to be placed next to the yoke or transom and the smaller outside for a locking nut. In the later type there is another nut that is on the piston rod between the yoke and the stuffing box. This is called the adjusting nut, and is used to adjust the gun in the slide; it also helps lock the rod to the yoke, and in the 7-inch this nut is also used as a spring compressor. In some of the types the rod extends beyond the piston and forms a plunger used for checking counter recoil, and in others the piston rod is counter bored from the face of the piston. When the cylinder is made of steel the piston is either made of bronze or has a bronze ring secured to its outer edge.

(5) *Stuffing boxes*.—(a) Stuffing boxes are the part of the bonnet that the piston rod passes through. They make it possible for the rod to work in and out without allowing the liquid to escape.

(b) The stuffing box is a machined out space in the bonnet in which packing is placed, and compressed by the gland that

screws into the outer end of it, as the bonnet screws into the cylinder.

(6) *Cup leather*.—Where cup leather is used the edge of the stuffing box does not hold the packing under compression, as there are holes drilled through the stuffing box into the cylinder, and when there is a pressure caused by recoil or counter recoil the pressure comes through the holes back of the cup and forces the edges of the packing against the metal and packs the joint. Cup leather packing is made of oil treated leather pressed into shape in a mould to conform to the shape of the place where it is to be used.

(7) *Packing*.—Other packing used is of the Seldon type, made of rolled canvas previously treated with a lubricant. There are others of fiber, braided like square sennit, which contain a lubricant. Both of these are issued in all sizes to fit stuffing boxes and are commercial articles. Packing containing rubber should never be used with glycerine, as this liquid softens it and makes it like gum. Packing found ragged when overhauling cylinders should be replaced with new. Before cutting new packing soften it by heating it or rolling it, and in cutting cut the ends on an angle, so that they will overlap and be of the same thickness as the rest of the ring when in place. Grease each ring with Albany grease and push it home with a packing stick, and when enough is in the stuffing box for the gland to reach it, set home with gland. After the last ring is in, set up hand tight with the wrench provided for that purpose, as it can be tightened when the cylinders are filled later.

513. Lost motion, elevating and training gear, broadside gun mounts.—

(1) *3-inch*.—The 3-inch training worm is split, and by setting up on the adjusting ring the two parts can be closed together tighter. This allows for wear and prevents whip. The same method can be used in the elevating gear where split worms are used. Lost motion in the training pinion can be taken up to a certain extent by calking the teeth of the pinion. The same can be done in the elevating gear pinion or arc, and in some cases the training rack can be shifted so as to shift the unworn part into use, replacing the part that has been used, as seldom more than half of the training rack is used at one time.

(2) *4-inch*.—The 4-inch of all Marks can be handled similarly.

(3) *5-inch*.—The 5-inch up to and including Mark XIII* has tin liners back of the training brackets and a movable section in the training arc.

* In the 5-inch Mark XIII and 6-inch Mark XII the worms on training and elevating gear have no adjusting rings, but the end of the shaft runs into an adjustable bearing, and this is locked by a locking plunger accessible from the outside.

(4) *6-inch*.—The 6-inch of all Marks up to Mark XI, inclusive, same as 3-inch. 6-inch Mark XII* is the same as the 5-inch Mark XIII.

(5) *7-inch Mark II, Mod. 3*.—(a) The training worm takes into the rack direct, and is mounted in a box that secures to the side of the carriage. It is fitted with another box on its inside, and through the sides of this box are fitted the shaft bearings of the worm, the bearing toward the breech being adjustable. The inner box can be moved in or out by two set bolts, accessible from the outside of the box, thus setting the worm in closer to the rack or withdrawing it for dismounting purposes. The outer part of the box is closed by a cover that slides in from the breech end and is slightly tapered, and by moving this in or out a fine adjustment is made, and the adjustment is regulated by a set screw with a knurled head at its breech end.

(b) The elevating gear pinion is divided or split transversely to its axis into two parts, one of which is keyed to the elevating pinion shaft, and the other free to rotate on this shaft, but is kept from so doing by projecting lugs on the inner face of the loose pinion, engaging by means of set screws with projecting lugs on the inner face of the fast pinion. By means of the set screws the loose section of the pinion may be rotated through a small angle to the fast section, so as to take up any lost motion between the elevating arc and the pinion.

(6) *7-inch Mark III, Mod. 1*.—(a) The training worm is mounted in the bracket direct. Behind this bracket are placed tin liners, and by removing them the worm is brought in closer to the rack. If the teeth of the rack become worn, the rack can be moved around so as to bring the unworn teeth in the working arc of the worm. The after worm bearing is adjustable as in Mark II, Mod. 3.

(b) The elevating gear has a movable section in the center of the arc that is adjustable at the upper end of the arc by a bolt and locked by a jamb nut.

(c) The training worm in this mount is of steel and the rack of bronze, so that the most of the wear will be on the rack, and this can be reduced to a minimum by a lubricant composed of Albany grease and cylinder oil, as the gear boxes are inclosed. This also applies to other types of inclosed gears.

(7) *Friction gear*.—Where friction training gear is in use, if the gun has a tendency to whip due to the pinion slipping on the rack, this can be helped by knurling the bearing parts of the pinion where they engage the rack, and also the rack.

* In the 5-inch Mark XIII and 6-inch Mark XII the worms on training and elevating gear have no adjusting rings, but the end of the shaft runs into an adjustable bearing, and this is locked by a locking plunger accessible from the outside.

(8) *Two-hand drive*.—Where the two-hand drive is applied to broadside mounts fitted with a shift lever, it may be found that the shift may jam in one position and cannot be raised; and in this case the flat spring back of the shift key will be found broken, necessitating the dismounting of the gear and replacing of the spring.

514. Sights for broadside mounts.—

(1) *Yoke sights*.—The sights for broadside mounts of recent date are of the yoke type, the general principles of which are as follows:

(a) Two telescopes are used, one for pointer and one for trainer. The pointer's telescope is usually located on the left side of the mount and the trainer's on the right side.

(b) The telescopes are fitted with cross wire illumination permitting of either day or night use. Most sights are fitted with one telescope having a checking eye piece for use in checking up the pointer and trainer.

(c) The eye pieces of the two telescopes are usually parallel to one another, but this need not be the case; they may be perpendicular to one another if more convenient for the operation of the mount, as in the case of the balloon and submarine mounts.

(d) In bore sighting, the adjusting of the telescopes is made by the adjustment of the cross wires or by adjusting of the telescope in its holder or by the adjustment of the telescope itself. The first means of adjustment is now being incorporated in the design of all telescopes, it being considered the more efficient. Telescopes are provided with different types of bearings, depending upon the means provided for the adjustment of same or of the means for fitting to the sight. Telescopes of the periscopic type are generally provided with two cylindrical bearings on the sight yoke and are fitted with cross line adjustment. Telescopes that are adjusted in the holder are fitted with spherical bearings, and those that are adjusted by the adjustment of its holder are provided with pentagonal bearings.

(e) The elevation and azimuth graduations for the sights are on adjustable parts that can be set at zero after the telescopes have been bore sighted.

(f) The sight is operated by the sight-setter, and in both elevation and azimuth from one side of the mount. Illumination of the sight scales is provided for night use, small electric lights being used for this purpose.

(g) The sights are designed to give as long a radius as possible to the sight bar and the azimuth head, thereby reducing to a minimum any errors in readings due to lost motion in the sight parts. The azimuth gear is also provided with an adjustable arc for eliminating any lost motion due to inaccuracy in manufacture or wear in the azimuth pinion and arc teeth.

(h) The sight elevation dial is graduated in yards. The sight bar graduation strip is, on the edge, graduated in yards, which are used as a check on the dial graduations, and on the outer edge in degrees and minutes, which are used as an arbitrary elevation scale.

(i) The azimuth drum is, on some sights, graduated in knots, but on other sights an arbitrary scale is used. The divisions on this arbitrary scale represent divisions of one-tenth of an inch on a 100-inch radius, these divisions running from zero to 100, the 50 division line being opposite the index line on the pointer when the sight is set at zero azimuth.

515. Sights, care and adjustment.—

(1) *Care*.—All working parts of the sight mechanism must be kept free from grit and rust and kept covered with a coating of good mineral lubricating oil. Oil holes are provided in the different sight parts for the proper lubrication of the sight operating mechanism. Sights that are exposed to salt spray should be disassembled, cleaned in alcohol, covered with a fresh coating of oil and reassembled. This should be done as often as it is considered by the gunnery officer that the conditions warrant such action. Emery paper or any gritty substance must not be used for cleaning. The sights are so constructed that any lost motion in the bearings and working parts, caused either by cleaning with emery paper or by wear, will materially affect the accuracy of the sight.

(2) *Lost motion*.—(a) Sights that are constantly used for Morris tube or dotter practice should be carefully tested for lost motion in the parts. To test a sight for this proceed as in bore sighting. If lost motion in any of the sight's parts has developed, the refitting of the sight should be done only by a skilled mechanic.

(b) The adjustment of the mount, as well as that of the sight, should be carefully checked. If the gun and the telescope objective are not parallel, there will be a vertical error in pointing, as the gun will not be at the elevation as indicated on the sight scale.

(c) To test the adjustment of the sight and mount, first adjust the trunnion bearing to insure good contact between the elevating arc and pinion, the lost motion in the other parts of the sight and mount having been previously eliminated. Now attach an accurately marked gunner's quadrant to the gun and another to the telescope, move the gun in elevation and depression, and if there is no error the angular change shown on each quadrant will be the same. (Should be done in dry dock.)

(3) *Graduation dial*.—(a) Sights are fitted with an elevation graduation dial which is used instead of the direct reading sight bar graduations, the dial admitting of a finer adjustment of the graduating scale. Lost motion in the sight elevating gear will more readily affect the readings on the dial. The lost motion in

this mechanism should be tested as follows: Lay the sight on a distant mark and, by means of the sight elevating mechanism, elevate the sight well above and depress it back to the distant mark, then depress below the mark and back to the distant mark. The ship being stationary, the reading on the dial should be the same each time the horizontal cross wire of the telescope is accurately laid on the distant mark; if not, there is lost motion in the gearing.

(b) The azimuth drum should be tested in a similar manner, using the vertical cross wires of the telescope instead of the horizontal wires.

(4) *Azimuth mechanism.*—The lost motion in the azimuth mechanism is eliminated by the adjustable arc in the yoke teeth or by the split pinion. There are no means provided in the earlier marks for taking up the lost motion in the elevating mechanism, as the weight of the sight bar and head should always keep the teeth of the rack and pinion well in contact. Later marks of sights have adjustable elevating arcs. This adjustment is accomplished by having an adjustable steel key which carries the center section of each tooth, and which can be set up to diminish the lost motion due to wear of the pinion by advancing the center part of each tooth sufficiently to take up the play.

516. Pressure gauges.—

(1) *Outfit.*—Outfits for use on board ship are no longer issued, but should one be used for any special purpose the following instructions would govern. The outfit consists of the following:

Chamber pressure gauges,	Gauge wrench,
Micrometer calipers,	Drift for working piston and cup,
Copper gas check cups,	Short cleaning rod,
Copper pressure discs,	Spare washers.
Pressure curves,	

(2) *Use.*—Chamber pressure gauges are placed loosely in the chamber of the gun or cartridge case. They are also designated as $\frac{1}{8}$ inch or $\frac{1}{16}$ inch area gauges, according to the area of the piston head. Each area of gauge has its own size of gas check cup and pressure disc. The $\frac{1}{8}$ area gauges are supplied with discs having an initial compression of nine tons per square inch; the $\frac{1}{16}$ area gauges have four tons initial compression. Each lot of discs carries with it a pressure curve constructed for that particular lot of discs, with which lot only can it be used. Thus a curve of pressures furnished with a certain lot of nine-ton discs cannot be used even with another lot of nine-ton discs made from different copper.

(3) *Directions for use.*—Unscrew cap, see pressure gauge thoroughly clean, well oiled and piston working freely; carefully

measure the copper disc about to be used with micrometer calipers and note this as the first measurement; place disc on top of piston head in center of pressure gauge chamber; see copper washer on cap shoulder oiled; screw on cap; push in piston from other end until disc brings up against cap; put a little oil over head of piston and force in gas check cup, concave side out, until it brings up against piston; smear tallow over gas check cup, smoothing it off flush with the end of the cylinder. After firing, unscrew cap, take out and measure the copper disc carefully with micrometer calipers, recording this as the second measurement. With the difference between this and the first reading (the compression of the disc) take from curve furnished with this particular lot of discs the pressure corresponding.

(4) *General rules.*—(a) Always use three gauges for each shot.

(b) Examine gauges carefully before and after using for scores caused by leakage of gas.

(c) When gauges are put aside they should be carefully cleaned and coated with vaseline.

(d) A gauge that has become scored by gas or expanded or contracted should never be used.

(e) When pressure gauges are used in B. L. guns they should be laid side by side, fore and aft, in the bottom of the powder chamber, just to rear of last section of charge and between it and mushroom face.

(f) In R. F. guns they should be placed in the bottom of the cartridge case around primers, and so as to be in *lower* side of case after it is loaded.

(g) In using pressure gauges the gun should be fired at an elevation of 5° to 7° , in which case they will usually remain in the cartridge case or powder chamber.

(h) Gauges using the same lot of discs should register within half a ton of each other. Should one of the three gauges register far out from the other two, its pressure should be thrown out in making up the average.

(i) In the 6-pounder, 3-pounder and 3-inch field and landing guns the $\frac{1}{10}$ area gauges with four-ton discs are generally used on account of their small size.

(j) The gas check cup need not be replaced until it shows signs of breaking up.

(5) *Manufacture of copper pressure discs.*—Copper rods for discs are delivered in bundles, burlapped for protection against damage in shipping. These rods are about six feet long and .32275 inch in diameter, with a plus tolerance of .002 inch. The rods are cut in a milling machine into discs of rough lengths about .02 inch longer than finished length. The rods are gripped in a grooved chuck, which permits the use of a gang of circular

saws properly spaced on an arbor. The discs are next pushed through a cylindrical die to give them the proper diameter. This is done by a long lever arm punch. The discs are now faced to length, a special arbor being used for this purpose. Two sets of tools are used, one roughing and one finishing, the arbor being so constructed that both ends of discs are faced simultaneously. The finished discs from each rod are kept separated so that those from any rod showing internal flaws or seams when pressure is applied may be discarded. The discs are then annealed in a current of hydrogen gas in an electric furnace, the temperature being controlled by a pyrometer. When cool the discs are removed from the furnace and given initial loads as follows: For the $\frac{1}{2}$ area discs, 9 tons per square inch; for the $\frac{1}{10}$ area discs, 4 tons per square inch. Speed of compression is limited to one inch in three minutes. The discs from any rod that show irregularities or flaws after the initial compression are reannealed or discarded, depending on condition. After all discs of a set have had initial strain applied a set is picked out at random from the lot and five are given each compression load desired up to the maximum strain. The resultant data and measurements are sent to the drafting room for the preparation of the compression curve.

517. Proof of guns.—

(1) Before being issued to service all guns are proved by firing at least five rounds, one at proof pressure, which is within the elastic limit of the gun and about 25% above the service or working pressure.

(2) The proof pressures and working pressures for the different calibers of guns are as follows:

Caliber of gun. (Inches.)	Length in calibers.	Proof pressure.	Working pressure.
		<i>Tons.</i>	<i>Tons.</i>
14	45	20	16.0-17.6
13	35	17	13.4-15.3
12	40	20	13.0-16.0
12	45	20	15.5-17.0
12	50	20	15.5-17.5
10	40	20	15.5-17.0
8	45	20	15.5-17.0
7	45	20	15.5-17.0
6	50	20	15.5-17.0
5	50	18	14.0-16.5
5	51	20	15.0-17.0
4	50	20	15.5-17.0
3	50	20	14.8-16.5
3 L. G.	25	13	11.5-13.0
6-pdr.	50	16	12.5-14.0
3-pdr.	50	16	12.0-14.0
1-pdr.	45	14	10.0-12.5

NOTES ON AMMUNITION.

518. Ammunition in general.—

(1) *Instructions*.—For the preparation and care of ammunition at naval magazines on shore, instructions are issued from time to time by the Bureau of Ordnance, and shall be strictly observed by all concerned. Attention is invited to U. S. Naval Instructions, Chapter 26.

(2) *Service ammunition*.—This is supplied as the ship's outfit for use only in battle. It shall not be used for drill, instruction, testing hoists, conveyors, etc. It shall be regarded as a part of the ship's outfit, shall be kept distinct from the ammunition issued for target practice, and shall never be expended in target practice without the authorization of the Bureau of Ordnance.

(3) *Target practice ammunition*.—Should be used for that specific purpose, and shall not be retained on board for long periods. It may, at the discretion of the commanding officer, be used for drill purposes.

(4) *Projectiles*.—Those comprising the service outfit of ammunition shall not be altered or disassembled on board ship, in any of their parts, without explicit instructions from the Department. Fuses shall not be removed from loaded shell except under explicit instructions from the Bureau of Ordnance. Projectiles shall be kept free from rust, and the paint or lacquer shall be renewed when necessary. The old paint shall be removed before painting, in order that the dimensions may not be increased thereby. Projectiles for separate loaded 5- and 6-inch guns are issued with their rotating bands protected by rope grommets or slings. The slings and grommets shall be removed only when preparing for firing, except in those cases where stowage space necessitates their removal before stowing in the shell rooms. Since the slings are liable to jam the hoists, they should be removed before sending the projectiles up. When removed, slings shall be returned to a naval magazine.

(5) *Primers*.—Combination (percussion and electric) primers will in the future be supplied for all main battery and intermediate battery ammunition, and simple percussion primers for all secondary battery ammunition. Combination primers will also be used in 3-inch ammunition until the present supply is exhausted, after which percussion primers only will be used.

(6) *Drill primers*.—With the exception of such as are designated as "drill" primers, primers in excess of an allowance of 10 per gun per year shall not be expended except in actual firing. A number of "drill" primers have been manufactured and issued for the purpose. In addition to these, the following main battery primers are designated and authorized to be used as drill primers: Simple percussion, simple electric and combination B. L. R. primers with magazine sealed with a crimped ring. Other models may from time to time be designated as drill primers.

(7) *Marking on ammunition.*—Since the correctness of reports and records depends upon it, care must be taken not to obliterate the identification marks on ammunition or to shift it to incorrectly marked containers.

519. Description of ammunition.—

(1) *Smokeless powder.*—

(a) Smokeless powder is now used in all guns except for saluting charges, ignition charges and bursting charges. The form now issued for all guns is a single or multi-perforated cylinder.

(b) For B. L. guns this powder is put up in cartridge bags, and the bags enclosed in airtight tanks.

(c) For the 14-inch and 12-inch guns, the charges are in four sections, two sections being placed in each tank.

(d) For the 10-inch, 8-inch and 7-inch guns, the charges are put up in two sections, one section in a tank, except the 8-inch/35, which has two sections in a tank.

(e) For the 6-inch and 5-inch guns, the charges are in one section, enclosed in a tank.

(2) *Ignition charges.*—At the base of each section an ignition charge is secured, composed of black cannon powder. The ignition end of all bags is dyed a carmine red.

(3) *Bursting charges.*—

(a) All armor-piercing projectiles of every caliber are loaded with a bursting charge of explosive "D" for all guns of 6-inch caliber and above. For guns below 6-inch and numerous projectiles still in service for large-caliber guns, the bursting charge is of black powder.

(b) The following table shows the weight of the bursting charge for projectiles of the various calibers:

Gun.	A. P. Projectile.	Com. Projectile.	Charge.
14-inch	31.4 lbs. ....	.....	Explosive "D."
13-inch	13.6 lbs. ....	.....	Explosive "D."
12-inch	22.5 lbs. ....	.....	Black Powder.
12-inch	24.0 to 24.7 lbs. ....	.....	Explosive "D."
10-inch	13.25 lbs. ....	.....	Explosive "D."
8-inch	6 to 6.2 lbs. ....	.....	Explosive "D."
7-inch	4.4 to 4.5 lbs.	5.50 lbs.	Explosive "D."
6-inch	2.4 lbs.	4.0 lbs.	Explosive "D."
6-inch	1.8 lbs. ....	.....	.....
5-inch .....	.....	1.70 lbs.	Black Powder.
4-inch .....	.....	1.10 lbs.	Black Powder.
3-inch .....	.....	.50 lb.	Black Powder.
3-inch L. & F. ....	.....	.35 lb.	Black Powder.
3-inch High Explos. ....	.....	.33 lb.	Explosive "D."
6-pdr. ....	.....	1300 gr.	Black Powder.
3-pdr. ....	.....	900 gr.	Black Powder.
1-pdr. ....	.....	180 gr.	Black Powder.

(4) *Tagging charges.*—

I. To each bag containing a part of a charge a cloth tag is attached stating:

- (a) The caliber of the gun for which it is intended.
- (b) The proportion of the charge that the bag contains.
- (c) The weight of the charge.
- (d) The index of the smokeless powder contained therein.
- (e) The initial velocity given by the full charge.
- (f) The amount of ignition powder contained in the

section.

(g) The initials of the inspector in charge of the magazine.

(h) The name of the magazine at which the powder is put up, and the date it is put up.

II. The bag is stenciled as follows: Caliber —, mark of gun —, charge — (full, $\frac{1}{2}$, $\frac{1}{4}$, etc.), weight of charge —, I. V. —, initials of tag inspector and no. of grammes on ig. end.

III. Attached to each tank is a tag giving the same information; except that the tag on charge also has psychrometer reading and number of weigher and assembler.

(5) *Fixed ammunition.*—

(a) Fixed ammunition is used for all 5-inch 40-caliber and smaller guns.

(b) For the 3-inch, 4-inch and 5-inch cartridges, the powder is put up in bags with an ignition charge at the base, the whole charge being placed in a cartridge case, except in the case where an extension primer is used.

(c) The projectile is forced into the mouth of the cartridge case until its rotating band is at the end of the case.

(d) The 1-pdr., 3-pdr., 6-pdr. and 3-inch landing and field gun charges are simply placed in a cartridge case, no bag being used, the ignition charge being in the primer. A pasteboard wad is placed over the powder, and a pasteboard distance piece between the base of the projectile and this wad, which holds the powder in place. The projectile is forced into the case in the same manner as the larger fixed ammunition cartridges.

520. *Tank and box markings.*—

(1) *Full charges.*—Each tank containing all or a part of a full charge is marked with a circular band, two inches wide, of *white* paint on the lid; with the index number of the powder stenciled on the *white* ground in not less than three-quarters-inch *black* lettering; also with caliber and mark of gun when same is stenciled on cartridge bag.

(2) *Reduced charges.*—Each tank containing all or a part of a reduced charge is marked with a circular *white* band; the index

number and R/C being stamped on the *white* ground in not less than three-quarters-inch *black* lettering.

(3) *Cartridge cases*.—The charges for the 6-inch and 5-inch cartridge case guns are put in cartridge cases, and no bags are used where an extension primer is used; otherwise a bag is used. Each case is protected by a wooden ammunition box. Tags giving the same information as that attached to the tanks for the B. L. guns are attached to the boxes for these guns, and the index number of the powder used is painted on the base of the case.

(4) *Fixed ammunition boxes*.—All fixed ammunition is boxed except 4-inch/50 long point, which is put in metal tanks, not painted except ends. The boxes are painted *lead color* with a fireproof paint. The contents of a box follows:

- (a) For the 4-inch and 5-inch guns, one cartridge,
- (b) For the 3-inch 50-caliber gun, four cartridges,
- (c) For the 3-inch landing gun, six cartridges,
- (d) For the 6-pdr. gun, eleven cartridges,
- (e) For the 3-pdr. gun, sixteen cartridges,
- (f) For the 1-pdr. gun, sixty cartridges.

(5) *Marking ammunition boxes*.—

(a) The boxes are painted to indicate the character of the projectile and type of fuse. The 5-inch, 4-inch, 3-inch 50-caliber, 3-inch landing and field, 6-pdr., 3-pdr. and 1-pdr., as follows:

Armor piercing, *all black*.

Forged steel, *all lead color*.

Shrapnel, *all white*.

Blind shell, *red*.

(b) A tag giving the same information as that on the tank is attached to the box; and the index number of the smokeless powder in the charge, also the mark and type of primer, are stenciled on each end, and on at least one side.

(c) Boxes containing fixed ammunition loaded with explosive "D" have cover (edges and top) *yellow*.

(6) *Box tag samples*.—

(a) 5-inch 40-cal. A. P. shell. L. & F.

Charge 15.8 lbs.

Index No. S. P. 24.

Ignition, 60 grammes fine-grain powder, or Pr. Ign.

I. V..... f. s.

..... Gunner.

..... Inspector.

Magazine, Iona Island, N. Y.....

..... 19..... lbs.

- (b) 7-inch or 8-inch..... cal.
 $\frac{1}{2}$ F. C.
 One-half charge..... lbs.
 Index No. S. P.....
 Ignition charge..... I. V..... f. s.
 Gunner.
 Inspector.
 U. S. Naval Magazine,
 19..... lbs.
- (c) 12-inch B. L. R.
 One-fourth charge..... lbs.
 Index No. S. P.....
 Ignition charge..... I. V..... f. s.
 Gunner.
 Inspector.
 U. S. Naval Magazine,
 19..... lbs.

(7) *Saluting charges.*—

(a) Boxes containing saluting charges are painted *lead color*, with top of box *half red* and *half white*, and are marked on top and front in *black* letters. Saluting charges are made up of black, pea-shaped cannon powder.

(b) Boxes containing signal charges for signal guns are painted *light blue*.

(8) *Drill cartridges.*—Boxes containing drill cartridges are painted *half black* and *half white*, with *white* and *black* letters.

521. *Projectiles.*—

(1) *Description.*—

(a) For the 14-inch, 13-inch, 12-inch and 10-inch guns only common and armor-piercing projectiles are provided. Common shell are not now manufactured for any gun larger than 8-inch.

(b) For the 7-inch, 6-inch, 5-inch, 4-inch and 3-inch/50 guns, armor-piercing and common projectiles and shrapnel are in service. Shrapnel are not now manufactured for any gun larger than 4-inch.

(c) For the 3-inch landing and field gun shrapnel and H. E. shell are issued.

(d) For the 6-pdr., 3-pdr. and 1-pdr. guns steel shell only are issued.

(e) All of these projectiles and shrapnel are issued loaded and fused, except such projectiles as are issued for target practice only, which do not contain any bursting charge, but are brought to weight with any convenient material.

(2) *Weight.*—All projectiles of the same caliber are now of the same weight, the common shell having been brought up to the

weight of the capped, armor-piercing projectiles. Following are the weights loaded and fused:

Caliber.	Weight.	Tolerance.
14-inch	1400 lbs.	4 lbs.
13-inch	1130 lbs.	3 lbs.
12-inch	870 lbs.	2½ lbs.
10-inch	510 lbs.	2 lbs.
8-inch	260 lbs.	1 lb.
7-inch	165 lbs.	¾ lb.
6-inch	105 lbs.	½ lb.
5-inch/51	60 lbs.	½ lb.
5-inch/50	60 lbs.	½ lb.
5-inch/40	50 lbs.	½ lb.
4-inch	33 lbs.	½ lb.
3-inch	13 lbs.	¼ lb.
3-inch field	13 lbs.	¼ lb.
6-pdr.	2735 grammes	.....
3-pdr.	1525 grammes	.....
1-pdr.	477 grammes	.....

(3) *Marking.*—

(a) The major caliber projectiles are marked as follows: On the base with the name of the manufacturer, lot number and date of specifications, and weight; on the rotating band, with the initials and stamp of the inspector of ordnance, caliber, kind, mark and modifications.

(b) The minor caliber projectiles have stamped on the base the name of the maker, and the lot and year of their specifications; and on the band the inspector's initials.

(c) The exterior of the projectile, except the rotating band, base and bourrelet, fuse, and the ogival for one caliber distance from the nose to the bourrelet, is coated with a thin, hard, smooth paint of the following color:

Armor-piercing	<i>Black</i>
Common	<i>Lead</i>
Shrapnel	<i>White</i>
Blind	<i>Red</i>

Target projectiles are painted *red* on the *ogival only*; rest of projectile vaselined.

Projectiles for fixed ammunition are *not painted* in rear of rotating band, but are given a thin coat of vaseline or heavy grease.

The bursting charge of all projectiles is indicated by painting the ogival a *distinctive color* for one caliber distance from the nose toward the bourrelet.

Projectiles loaded with black powder have nose *lead color*.

Projectiles loaded with explosive "D" have nose *yellow*.

Projectiles blind loaded have nose painted *red*.

Projectiles fitted with night tracers, and tracer fuses, have a *white* band one inch wide painted around the ogival just below the color indicating the bursting charge.

522. Primers.—

(1) Single electric primers are issued for drill and testing firing circuits.

(2) For the B. L. guns, only combination primers are now manufactured.

(3) For the 6-inch, 5-inch and 4-inch R. F. guns a combination extension magazine screw primer is manufactured; also they use a short-drive primer which requires bag and ignition charge. The short-drive primer is also supplied to 3-inch/50 guns.

(4) For the 3-inch 50-caliber only combination or percussion extension magazine screw primers are now issued.

(5) For smaller guns only percussion common primers are now issued.

523. Fuses.—

(1) The following fuses are being manufactured for issue to the service:

(a) For 6-inch and above, tracer detonator fuses.

(b) For 4-inch and 5-inch, Semple med. cal. tracer fuses.

(c) For 3-inch and below, Semple minor cal. tracer fuses.

(d) For shrapnel, 15-sec. F. A. C., and 21-sec. F. A. C.

(2) A number of Watson, Semple, Merriam, etc., base-percussion fuses are still in use where shell are loaded with black powder.

524. Cartridge cases.—

(1) *Care and preservation.*—To prevent the rapid deterioration of metallic cartridge cases the following rules must be observed for their care and preservation:

(a) The cases at all times, whether before or after firing, should be kept free from salt moisture, oil, or grease of any kind, and from time to time, as opportunity occurs, they should be examined, especially at the neck and mouth, for signs of corrosion.

(b) The larger cases when empty should not be laid on their sides, except unavoidably, but should be stood up on end. The cases should not be replaced in their boxes until examined for powder gases, and decapped and washed.

(c) As soon as possible after firing, the firing primers should be backed out; the cases thoroughly cleaned and dried, and turned in with empty cases for reloading.

(d) If the residuum is found difficult of removal, a little lye may be added to the water used in cleaning, but hot soapsuds will usually suffice, the soap being not used in lumps. After cleaning, the cases should be rinsed with clean water, drained, thoroughly dried, inside and out, and put away in their boxes.

(e) No oil or grease of any kind should ever be used on the cases, except in the operation of reforming, when they may be

lubricated with soapsuds, or a very light coat of equal quantities of white lead and tallow.

(2) *Reforming and reloading.*—The following is a description of reforming and reloading tools for minor caliber R. F. guns. The tools are no longer issued to ships, but are in use at all naval magazines.

(a) *Dies.*—Steel, cylindrical in form, of 4-inch outside diameter, 17.5-inch length, and bored to dimensions slightly less than the cases they are to reform. A number of small holes (air vents) are drilled through at various parts of their length to prevent dishing the case, and each die is fitted with a bronze handle placed over its center of gravity.

(b) *Ejectors.*—Steel, turned from a single piece, and of dimensions to go in the mouth of the corresponding case.

(c) *Decapping tool.*—A cylindrical steel rod, 0.5 inch in diameter, 11.6 inches long, terminating in a conical point rounded on end.

(d) *Cap-follower.*—A steel disc of 4-inch diameter, counterbored at its center to avoid compressing the primer cap, and with cylindrical handle projecting from its rear face.

(e) *Reloading blocks.*—Hollow bronze cylinders counter-sunk on the end to fit the heads of the different cartridges, and bored through to avoid contact with primer.

(f) *Point centering block.*—A bronze cylindrical disc, bored at the center with an ogival-shaped counter sink, and having on its rear face a hemispherical boss one inch in diameter.

(g) *Body centering blocks.*—Bronze half cylinders, bored out to 1.834 inches, and 2.224 inches, respectively, for centering the 3- and 6-pdr. shell in reloading.

(h) *Bed.*—A bronze casting, semi-cylindrical in section, cast with flanges to secure it to a bench, ribs to stiffen it, and lugs at each end to take the thrust. A slot is cut through the bottom of the bed. The inner lug is finished on both faces and bored through in the axis of the semi-cylinder to receive a flanged nut, which rests on a frictionless washer placed between the flange and the lug face. The nut is fitted with a lever on its inner end, and is tapped to take a screw with a rectangular thread. This screw has a face plate in one with it. The face plate has a lug on its lower side, which passes through the slot in the bed, and is prevented from rising by a nut which is screwed on from below. A hinged clamp, bored out to a 4-inch diameter, and with a slot cut on the inside to take the rib on the centering washers is fitted to the bed.

(i) *Centering washers.*—Steel rings, bored to fit the neck of each caliber and class of cartridge and cut in halves. They have a rib on the outer circumference which fits in the slotway of the clamp and bed.

(3) *Directions for use of tools.*—See that the cartridge cases are clean, free from grease and verdigris inside and out, and that the primers have been backed out with the decapping tool, or unscrewed, depending on type of primer.

(a) Wipe out the inside of the die.

(b) Lubricate the case thoroughly with white lead and tallow, equal parts, or soapsuds, spreading it evenly with the hand and removing any grit encountered.

(c) Run the screw out as far as possible, open the clamp, put in the die, fasten clamp.

(d) Insert the cartridge and screw home, taking at least forty-five seconds.

(e) Withdraw screw, insert primer squarely, place the cap-follower against it and screw home. Slack screw and remove cap-follower.

(f) Insert ejector from the rear, unclamp, turn the die end for end, screw up and force cartridge case out to rear.

(g) Pour powder charge into case, a little at a time, shaking it well down; place a wad over the charge, remove die and put in reloading block and lower half of centering ring belonging to the caliber.

(h) Place cartridge in position with base against reloading block and neck on centering ring, put in upper half of centering ring and fasten clamp. Run screw out.

(i) Put in point centering block, being careful that it rests squarely against the face plate. (If for a 3- or 6-pdr. also place the body centering block.) Place nose of shell in centering block and base in cartridge case. Then screw slowly home until the rear edge of hand just reaches lip of case.

(j) Remove completed cartridge.

(k) In reloading ammunition for rapid fire guns of all calibers the rim of each cartridge case shall be nicked on the edge with a file, so that the number of marks on a case shall indicate the number of times it has been fired.

(l) Whenever reloaded cases are packed in boxes, the place and date of the last loading shall be noted on the label.

NAVY SMOKELESS POWDER.

525. Manufacture.—Smokeless powder, as manufactured at present for the U. S. Navy at Indian Head, Md., and at the works of private contractors, is composed essentially of cellulose nitrates produced by the action upon cotton fiber of a mixture of nitric and sulphuric acids. After nitration the material is thoroughly purified by repeated washing and boiling, with pulping to facilitate the removal of impurities and to reduce the material to a fine state of division for the subsequent operations. After it

is freed from water by wringing and by dehydration with alcohol, it is mixed with ether. The ether, together with the alcohol remaining from the dehydrating process, forms a solvent, which reduces the nitrated cotton to a colloid capable of being readily pressed into the desired shape, *i. e.*, formed into grains of powder. Some of the solvent is recovered in the drying processes, which are continued until a standard condition of dryness is attained, when the grains will have shrunk to the designed dimensions. When dried the powder retains its character as a colloid, but its consistency is changed. It is transformed from a gummy mass to a hard, tough, hornlike substance of dark color, which, when ignited, burns in layers parallel to the surface. A more detailed description of the process of manufacture, with especial reference to Indian Head practice, follows:

526. Prime materials, preparation.—

(1) *Cotton*.—Various forms of cotton fiber have been used in smokeless powder manufacture. Mill waste was for many years the material commonly used in nitration, and its cheapness and fair suitability have made it available to the present time. Clippings from woven cotton goods have also been used, but less successfully. The most adaptable material at present is short fiber cotton, obtained through the removal, by a special process, of the fiber ends which adhere to the cotton seeds after ginning. This cotton has a nature and appearance much resembling that of coarse lint. There are few uses to which it can be put, outside of the manufacture of powder, and it is, therefore, fairly cheap, as well as particularly suited to the purpose of powder making. It nitrates well because the acids have easy access to all parts of it, requires less time in pulping than long-fibered cotton, and has a consistency more favorable to easy working in the subsequent processes.

(2) *Purification*.—The cotton received at the Indian Head factory is previously purified by the contractors. The purification process usually consists in boiling with caustic soda to saponify the waxy constituents of the cotton fiber, and render them and other impurities easily removable by washing. The material is bleached with chlorine and washed with cold water to remove the original impurities, together with the materials used in purifying and bleaching, and then is dried until it contains less than seven per cent of moisture. It is made up into small pressed bales for shipment.

(3) *Picking*.—The baled cotton is picked by machines to loosen it before drying and nitrating. The short fiber and long fiber grades require different machinery for picking; the former is combed out, or carded, in a mill having toothed rolls; the latter is ground between a pair of ribbed or corrugated plates, being fed in through a hopper from above. Short fiber cotton, falling from the picker in a more or less fine state, is blown by air through a

chute to the bins, from which it is taken in canvas bags to the cotton dry house. The long fiber mill allows the cotton to fall directly from its rolls into the bin.

(4) *Drying.*—

(a) The cotton is dried immediately before nitration, as too much moisture will have a bad effect in that operation, giving irregular results and sometimes causing the material to burn. The cotton, as received, contains, as stated, less than seven per cent of moisture, and this is reduced in the cotton dry house to less than one per cent.

(b) The picked cotton is emptied from the large canvas bags in which it is received from the picking house, and packed loosely into bins with wire mesh bottoms, lined with burlap. Each bin is connected with a duct from a sectional steam coil air heater. A fan blower drives air through the heater and delivers it to the duct. The duct has several branches opening under each bin, and the heated air, passing through these, rises through the cotton and passes out through a grating in the floor of each binroom to a flue on the outside of the building. The designed temperature in the bins is 100°C ., and the usual time of drying is about twelve hours. A thermometer is kept in each bin, and the temperature is regulated by cutting in or out sections of the heater.

(5) *Acids.*—At Indian Head the major portion of the mixed acid used for nitration is manufactured in the station acid plant; the remainder is received from contractors in tank cars, already mixed. The mixture is required to contain not more than 45.5% of sulphuric acid, and not less than 49% of nitric acid, and to have a total acidity of not less than 95%.

(6) *Fortifying spent acids.*—Acid of the above strength is not used directly in the nitration of cotton, but is mixed with weaker acid (spent acid) recovered from previous nitrations. This mixing is known as fortifying the spent acid. The usual acidity of the mixture used in nitration is about 85%, although this is not fixed, but must be varied from time to time, depending upon conditions, to secure the proper percentage of nitrogen in the nitrated and purified cotton. A sample is taken from each tank of spent acid before fortifying, a chemical analysis made and the quantity of fortifying acid to be added is calculated. The proportion of nitric acid to sulphuric acid in the nitrating mixture is about two to one by weight. The mixture is heated in special heating tanks by means of hot water coils to a temperature sufficiently high to ensure its being delivered to the nitrating wringer at about 33°C .

527. *Nitration.*—

(1) *Acid wringers.*—The nitration of the cotton is carried out in nitrating centrifugals or "wringers." The common type of wringer consists of a cylindrical cast iron casing about four feet in diameter, and about three feet high, enclosing an inner tank or basket of perforated sheet iron pivoted on a central rotating shaft,

which is driven by belts and shafts from the source of power, usually an electric motor. The wringer shaft rises from a well below the casing, and runs up through it, being housed inside the basket for protection against acids. The casing has a cupped lip at the top to prevent spilling of acid, and a hinged cover. Hand levers near the wringer provide for throwing in a clutch on the motor shaft to rotate the wringer, and for applying a friction brake to stop rotation when the power is off. Each wringer receives heated mixed acid through a pipe and valve above, and discharges spent acid by gravity through a valve and pipe line below. The fumes are carried off during nitration through large pipes let into the cover of each of the wringers.

(2) *Mechanical process.*—The process of nitration is carried out as follows: About 1500 pounds of mixed acid is admitted to the wringer from the heating tanks. Thirty pounds of cotton is put into the wringers and immediately immersed. An iron devil's claw is used in working the cotton about in the acid. The cotton is digested in the acid for a period of twenty minutes, during which time it is frequently stirred. The spent acid drain valve is then opened, the wringer cover is closed, and the clutch thrown in to revolve the wringer. The speed is about 750 revolutions per minute, and the operation is continued about one minute. During this time most of the free acid will be drained from the cotton by centrifugal force, and will run out to the spent acid receiving tanks. The cotton will have been converted to cellulose nitrates of slightly varying degrees of nitration. The nitrogen content required is 12.50 ± 0.10 after purification.

(3) *Chemical process.*—The chemical processes accompanying nitration are not established beyond question. The following is, briefly, one theory: The sulphuric acid in the nitrating mixture acts first upon the cotton, forming cellulose sulphates and liberating water. The nitric acid then acts upon these sulphates, displacing the sulphuric acid and forming cellulose nitrates. The liberated sulphuric acid combines with the water previously set free to form hydrates. The cellulose sulphates are not completely converted to nitrates, and small amounts of them remain after nitration, to be removed in purification.

528. *Purification.*—After nitration, the nitrocellulose, which will hereafter, for convenience, be called pyrocellulose, must be purified to remove free acids, cellulose sulphates and other impurities which may be detrimental to the stability of the product. The following are the steps in the purification process:

(1) *Drowning.*—When the free acid has been drained from the wringer, as described above, the pyrocellulose is immediately transferred to a wooden drowning tank filled with fresh water, and is completely immersed; for, if the freshly nitrated pyrocellulose is exposed to the air for any length of time, still containing, as it does, some of the nitrating acids, even after the wring-

ing process, it often takes fire spontaneously and burns with brown fumes. There is usually one drowning tank for each wringer, and each is mounted on a low wheeled truck, so that it can easily be moved from the acid wringers to the water wringers. The pyrocellulose is allowed to remain in the drowning tank for a few minutes, when the tank is drained, the water carrying off with it a large part of the free acid remaining before drowning. The tank is run across to one of the water wringers, and the pyrocellulose transferred to the latter. The water wringer is like the acid wringer, but has connection for fresh water instead of acid. Here the material is wrung out for five minutes, with constant circulation of fresh water from a hose, the speed of the water wringer being the same as that of the acid wringer. In this operation the free acid is further eliminated, and, at its conclusion, the pyrocellulose is ready for the preliminary boiling.

(2) *Preliminary boiling*.—From the water wringer the pyrocellulose is taken to the boiling tubs, which are cylindrical wooden tanks, each fitted with a water supply pipe at the top, a water drain at the bottom and a steam supply pipe leading down one side within a wooden trunk to a perforated horizontal length under the wooden false bottom. The closely spaced strips of this false bottom let the water and steam circulate, but keep the pyro away from direct contact with the hot steam pipe. The tub is filled nearly to the top with fresh water, the pyrocellulose is immersed and the steam turned on. The temperature of the water is raised to 80° C. and kept there for a short time, when the steam is turned off and the water drained out. The tub is refilled with water, the temperature is raised to 100° C. and boiling is continued for four hours. This boiling is then repeated three times, changing the water each time. No mechanical working is given during the preliminary boiling.

(3) *Pulping*.—After the boiling described above, the pyrocellulose is taken to the pulpers, where it is thoroughly macerated in order to permit the remaining impurities to be more easily removed, and in order to give it the fine state of division necessary in the subsequent operations. The type of pulper ordinarily used is practically the same as is used in many paper mills for the pulping of rags. It consists of a long, box like, cast iron tank with a large cylindrical rotating roll running across it horizontally to the center. Above and below the roll are concave plates secured to the top and bottom of the pulper, respectively, running across the pulper parallel to the axis of the roll and fitting the roll very closely in arcs of about 20° at the top and bottom. The roll and the plates have longitudinal sharp edged ribs, which cut the pyrocellulose as it passes between them. The pulper is kept nearly full of water during operation, and has a horizontal diaphragm extending nearly its whole length at the level of the axis of the roll, which directs the circulation of the water and pyrocellulose downward at the rear, forward between the roll and the

lower plate, and upward at the front and to the rear between the roll and the upper plate. The pulping operation is continued usually about eight hours. When the pyrocellulose has been reduced to a sufficiently fine state, in the judgment of the man in charge of the pulpers, it is run, together with the water in the pulper, through a pipe line to the poachers. Between the pulpers and the poachers it passes through a fine screen, which retains the particles that are still too coarse. The coarse material is returned to the pulpers for further working.

(4) *Poaching*.—

(a) The poachers are cylindrical wooden tubs, much like the boiling tubs. There is a perforated steam pipe on the side behind a sort of baffle. There is a pyrocellulose inlet and outlet, a drain and a water pipe. There is a vertical shaft in the center, which works revolving paddles to stir the contents of the poacher during the boiling process. When the desired charge of pyrocellulose has been admitted to the poacher, the water is raised to within about eighteen inches of the top, the steam is turned on, entering at about mid height under the water, and the paddles are revolved. The temperature is raised to 100° C. and boiling continued six hours. The steam is then shut off, the paddles stopped and the pyrocellulose allowed to settle for one hour, when the water is decanted off the top by opening the drain valve, the poacher again filled with fresh water and brought to the boiling temperature. Boiling is continued two hours, then for four one-hour periods; settling one hour, decanting, changing water and bringing up to heat each time. After the final boiling the poacher is again decanted, filled with fresh water and the pyrocellulose given a half-hour washing by stirring without heat. It is then allowed to settle for one hour, decanted and filled. Ten washings are given, following the procedure outlined above.

(b) A sample of the pyrocellulose is then taken from the poachers, and is given the prescribed heat tests in the chemical laboratory. If it passes these tests, or, in other words, if its condition of purity is satisfactory, it is run out to the wringers. If not it is given further treatment in the poachers until it can pass the test. Each poacher lot of pyrocellulose is given a number, and this is carried by the material through the later processes until it is blended as finished powder with other poacher lots to form a lot or index of powder.

(5) *Wringing*.—From the poachers the pyrocellulose and water runs through a pipe to a centrifugal wringer, where most of the water is wrung out. The pyrocellulose, leaving the wringer, still contains about 40% to 45% of water.

529. Dehydration.—From the wringers, the pyrocellulose is taken to the dehydrating house. Here the remaining water is removed, and the alcohol constituent of the solvent is introduced by the following process: About 50 pounds of pyrocellulose is intro-

duced into the cylinder of a vertical hydraulic press, having pistons entering it from above and below, and is put under a pressure of about 200 pounds per square inch. A dense cake is thus formed, but very little water is pressed out. The upper piston is raised, and the upper end of the cylinder closed by a lid. Alcohol is run in on top of the cake, and air under pressure of 75 pounds is admitted. The alcohol runs through the cake, leaching the water out with it. The mixed liquid runs off through channels in the lower piston to a drain. When the flow has about ceased the air pressure is removed, the lid taken off the cylinder, and the upper piston again entered. A pressure of 3000 pounds per square inch is then applied by means of the pistons, and is kept on usually two minutes. This removes the excess of alcohol, and that remaining is the amount desired as a constituent of the solvent.

530. Mixing.—The pressed cake from the dehydrating house is carried to the mixing house, where it is broken up into one of the mixers. The mixer consists essentially of a rectangular casing, water jacketed for cooling, in which two shafts carrying helical knife-shaped blades revolve in opposite directions. The pyrocellulose has been put into the mixer, and mixed dry for twenty minutes, a quantity of ether is added, which is about twice the weight of the alcohol already present and remaining from the dehydration process. Diphenylamine, which is used as a stabilizer to retard decomposition, is added at this time in solution in the ether. The amount used is 0.45% of the dry pyrocellulose, or about 0.40% of the finished powder by weight. When the solvent and stabilizer have been added the charge is again mixed for thirty minutes. The pyrocellulose is somewhat colloided in this process, but is rather dry, resembling moist cornmeal. It is made into cylindrical blocks in a hydraulic blocking press and sent to the straining presses.

531. Straining.—The pressed block is placed in the cylinder of a strainer press whose bottom has a large number of small perforations, through which the colloid is forced under a pressure of about 1300 pounds per square inch by a piston descending from above. The small spaghetti-like cords of the colloid descend from the strainer press into a cylinder of a blocking press directly below in which they are again pressed into a block. The straining process gives the colloid a more thorough mixing, insures greater homogeneity, and removes any particles of foreign matter too large to pass through the perforations. After this straining and blocking process the colloid is more or less translucent and jelly-like, and somewhat tenacious like a very stiff glue. It is of such nature that it is capable of being worked into almost any desired shape under pressure, and when later dried becomes tough and hard like horn.

532. Pressing and cutting grains.—The graining presses are hydraulically operated and are much like the strainer presses in

operation, but are placed horizontally and have a diaphragm carrying a die, where the others have a perforated strainer. The dies and diaphragm are both removable, and the dies may be changed to suit the grain dimensions desired. The diameter of the die opening determines the diameter of the grain as it issues from the press, and pins fitted centrally in the die give the perforations of the finished grain. There are seven perforations, arranged as follows: One in the axis of the grain and the other six around this central one, equi-distant from it and from each other. Some of the smallest powders have only a single central perforation. The block of colloid from the strainer and blocking press is placed in the cylinder of the graining or finishing press and is forced, by the pressure of a piston, out through the die, whence it emerges in a long, perforated cord. The pressure is usually from 1800 to 2500 pounds per square inch, depending upon the nature of the colloid and the size of the grain to be cut. The cord moves along a table, where it may readily be inspected by the operator of the press, and enters a cutting machine, where a sharp revolving knife cuts it into grains of the desired length. The cutting machine is driven by a belt and pulley, and the length of the grain may be varied by changing the size of the pulley and of the gears between it and the cutting knife. Before leaving the press house the grains are given a preliminary inspection, and any imperfect grains found are scrapped for return to the mixers.

533. Drying.—The "green" powder from the presses contains a large excess of solvent, which must be dried out in order to give the powder the rapid burning quality necessary for proper ballistic results. The drying is carried out in two steps as follows:

(1) *Recovery of solvent.*—A rapid preliminary drying is given for the purpose of evaporating and recondensing a portion of the solvent so that it may be used again. Several different kinds of drying tanks are used for this purpose, but the principle of all is the same. A current of heated air is passed through the powder, volatilizing a part of the excess solvent. The current of air then passes through or around brine-cooled coils, where the vapors of the solvent are condensed and the liquid led off to a collector. The temperature of the powder during the process is varied between about 27° C. and 39° C., starting low and gradually rising. The period of drying varies, usually running from three to five days. The greater part of the solvent recovered is ether, as it is more volatile than alcohol. After this preliminary drying the powder is again inspected for defective grains.

(2) *Dry houses.*—The final drying is a gradual one carried out in a dry house of large capacity. Several different types of dry houses are used. All depend upon heating the powder to a uniform temperature and differ principally in the provisions for heating and for the circulation of air. When first received the powder

is placed in small bins, and is usually dried without heating for sixty days. The temperature is then raised, usually to about 40° C., and maintained uniformly at the desired figure until the drying is completed. The rate of drying, under given conditions, depends upon the average web or the wall thickness between the different perforations and between the perforations and the outside surface of the grain, thin-webbed powders drying faster and losing a greater percentage of their solvent. Experience has indicated the average amount of residual solvent which will remain in a powder of given web thickness when it has been dried to the desired dimensions and burning quality, and this is used as a guide to the proper duration of drying. Determination of the residual volatiles (solvent and moisture) by analysis at intervals near the estimated end of the drying period will fix the point sought. The percentage of volatiles remaining in our powders varies from about 3% in small caliber powders to about 7% in the large ones.

534. Blending and packing.—The powders in the dry houses are still kept separated in poacher lots. The grains are, of course, of the same dimensions. After the drying is completed they are blended to form the lot of powder called for by the order under which they are manufactured. There are several different methods of blending. The blending tower method is probably the best now in use. The tower consists of a series of bins in groups, one group above the other, with a space of about twenty feet between. The bins of each group are arranged in polygons, each having a narrow corner in the center of the group. In this corner of each bin is a trap or sluice valve. The uppermost group of bins being filled with powders of different poacher lots, these valves or gates are opened simultaneously and the powder passes down to the next group of bins in one stream and falls about equally into the different bins of the lower group. The operation is repeated until the powder has passed through three or four groups of bins and reached by a large hopper at the bottom, from which the blended powder may be drawn off into the zinc-lined boxes in which it is packed and shipped. During filling each box stands on scales under the hopper and is weighed as it is filled. After filling, the boxes are sealed with air-tight covers and placed in a magazine to await assignment and shipping. The boxes are marked with the factory designation of the powder, the gross and net weights and the date of packing. From the last powder packed a firing sample is selected of sufficient quantity to allow for proof of the lot of powder in a gun of the caliber and type for which it is intended. The usual quantity of powder now incorporated in one lot is 100,000 pounds for powders above 4-inch and 50,000 pounds or 25,000 pounds for smaller caliber powders, according to the specifications.

535. Proof of powder and assignment of charges.—

(1) *Service charges.*—Each lot of powder is proved at the Proving Ground by firing before being issued to service in order to determine whether the powder is suitable for the gun for which it is intended, to develop curves for velocities and pressures and to determine the weights of charges necessary to give desired velocities. The conditions are standardized as nearly as possible for the proof firing. The powder is always brought to a uniform temperature of 90° F. by slow heating. The shells are brought accurately to weight, bands of the same dimensions are used for proving all powders in guns of a given caliber and mark, the shells are carefully measured, and the seating or distance from the base of the shell to the rear end of the tube is taken for each round. Velocities on each round are measured by chronographs. Four or five rounds are usually fired, beginning at about 150 to 200 foot seconds below service velocity and working up to about 100 foot seconds above service. This develops the curve accurately near the service velocity, and the service charge can be accurately determined. During the proof firing a sample of about 1½ pounds is sealed in a glass jar and sent to the chemical laboratory for chemical acceptance tests. A portion of this sample is retained in the laboratory for surveillance tests and permanent observation.

(2) *Reduced charges.*—

(a) A low velocity round is fired during proof of powder, so that the weight of the charge giving the reduced velocity for target practice can be determined if it is desired to assign the lot to target practice use. It sometimes happens that a powder is too slow or too quick for a gun in which it is intended for use and is unsuitable for service velocities because of undesirably high pressure developed at some point of the projectile's travel. Such a powder may be entirely suitable and satisfactory at lower velocities and can be used for target practice as well as could a powder suited to service velocities.

(b) After proof a test sheet is made up at the Proving Ground, giving all data about the powder, chemical characteristics, physical dimensions, etc., and recording the proof data as to pressures and velocities, in both tabular and graphical form. A copy of this sheet is sent to the Bureau of Ordnance, which accepts the lot, if it is satisfactory, approves the weights of the charges determined for given velocities, assigns a service index number to the lot and directs its shipment to a designated magazine. At the magazine the powder is made up into charges, as directed by the Bureau of Ordnance, for either service or reduced velocities, and is sent to ships in tight copper or galvanized iron tanks, in which it is kept until expended or turned in to a magazine.

536. Care of powder in storage.—

(1) *On shipboard.*—The utmost care should be taken on shipboard and in other places where powder is stored to keep the

containers tight, to maintain as low a temperature and as dry a condition as practicable in the magazine and to observe strictly the precautions and tests required by the Regulations. The causes which lead to chemical changes and decomposition in powders, with resulting decrease in their stability, are greatly favored by high temperatures and by the loss of solvent through the entry into and escape of air (especially moist air) from leaky containers. The present stabilized powders promise a long stability life, and, in any case, a careful carrying out of the prescribed tests will definitely indicate an advancing condition of decomposition before the powder becomes dangerous from this cause.

(2) *Dangerous powder*.—A powder which, through loss of solvent in the way described and entirely apart from any question of decomposition, has acquired a more rapid rate of burning, and may therefore produce abnormal pressures in a gun, has commonly been called a dynamically dangerous powder. The only way of detecting such a change in powder on board ship is by means of pressure gauges, comparing the pressures observed with those given by the same charge when the powder was proved and the charge assigned. With the present containers and with proper precautions in storage there is little likelihood of the development of a dynamically dangerous condition in our powders, but this fact should not cause any relaxation in the care and vigilance with which the powder is kept under observation.

(3) *Ballistic properties*.—It has been seen that a loss of solvent or drying out of powder may seriously affect its ballistic properties. The temperature of the powder at the time of firing has also a definite ballistic effect, a variation of 1° F. near 90° F. at which the powder is proved causing a difference in muzzle velocity of about two foot-seconds. The precautions necessary to preserve the ballistic condition of the powder, uniform low temperature and dryness of magazines, together with air-tight containers, are therefore the same that will in greatest measure preserve its stability.

PRESERVATION AND TESTS OF POWDER.

537. Care, handling and stowage.—

(1) *General*.—All persons in the naval service whose duty it may be to supervise or perform work in connection with the inspection, care, preparation, or handling of explosives, should exercise the utmost care in the performance of such duties. All regulations and instructions bearing on this subject must be rigidly observed, and no relaxation of vigilance with respect to them must ever be permitted.

(2) *Volatiles*.—Navy smokeless powder is manufactured to contain in the finished grain a standard percentage of "residual volatiles," which is as low as practical considerations will permit. Under normal conditions of storage the volatiles will not become appreciably reduced. Furthermore, powder is packed at the factory and charges are made up at the magazine under normal atmospheric conditions as far as practicable to obtain a standard percentage of surface moisture. The charges for breech-loading guns are issued in air-tight tanks, and charges for cartridge-case guns are virtually sealed by the mouth cups or the projectiles. The weights of charges are fixed by actually firing the various indexes under standard conditions of volatiles, temperature, etc., and it is most important, for ballistic reasons, that the powder undergoes no change in service thereafter. To insure this, those charged with its care should see that the air-tightness of the containers is rigidly maintained. Powder exposed to the atmosphere will lose a portion of its residual volatiles, and on board ship will gain or lose surface moisture. While the changes may be counter-active, it is unlikely that they will exactly offset each other. Therefore, the importance of keeping powder charges air tight is to be considered on a par with that, for instance, of keeping the sights in condition.

(3) *Temperatures*.—The "proof" of powder, besides being held under normal conditions as regards volatiles and moisture, is conducted with the powder at that temperature which closest approximates that of ships' magazines. Variations in storage temperatures do not affect the ballistic qualities, provided the powder is brought to standard temperature before firing. Loss of stability, unless it has gone as far as to preclude retaining the powder on board ship, will not affect ballistics if the other conditions are normal.

(4) *Handling*.—Ammunition shall be handled as little as possible, since it is often the cause of deforming powder tanks and cartridge cases, to the detriment of their air-tight condition. Powder stored for a considerable period in a non air-tight container is apt to deteriorate rapidly, introducing the danger of spontaneous combustion. Charges that are not in air-tight containers should be landed for repairs or replacement. When ships receive from magazines ammunition that shows rough handling, the circumstances should immediately be reported to the Bureau of Ordnance. Magazines shall make similar reports regarding ships. Too much care cannot be given to keeping powder in air-tight containers. Moreover, excessive handling is apt to make dents in cartridge cases, loosen projectiles, etc. The cartridge bags for B. L. guns are made of the most suitable material obtainable and, when issued, have ample strength. However, the sharp edges of powder grains will cut through the bags if the charges are handled too much.

(5) *Unexpended ammunition.*—The unexpended portion of such ammunition as may have been issued for a specific target practice or experimental firing shall be turned in, as soon as practicable after such firing, to a naval magazine on shore; if practicable, to the magazine from which such ammunition was obtained.

(6) *Exposure to sun.*—

(a) When smokeless powder is removed from magazines on shore or on board ship for transportation, target practice, or other purposes, it shall not be exposed to the direct rays of the sun or subjected to other abnormal conditions of temperature. This prohibition applies equally to powder in bulk, in tanks, cartridge cases, ammunition boxes, or other containers. Whenever it may be necessary to transport smokeless powder ammunition in boats, or to take it on shore, as for boat-gun or field-gun target practice, it must be effectively shaded from the rays of the sun.

(b) Whenever, in particular cases, the terms of the above paragraph have not been complied with, any ammunition which may have been exposed shall be segregated, and shall, for purposes of tests, inspections, and reports be regarded as a separate index; and, if on board ship, it shall be landed at a naval magazine at the first opportunity should there be reason to believe it has deteriorated.

(7) *Temperatures above 100° F.*—If at any time smokeless powder be exposed to a temperature higher than 100° F., a special report shall be made to the Bureau of Ordnance immediately, explaining the circumstances in detail and stating the temperature and the length of time the powder was so exposed.

(8) *Stowage.*—

(a) As far as practicable, smokeless powder for different calibers shall be stowed in separate magazines.

(b) Black powder (except ignition charges) shall not be stowed in the same magazine with smokeless powder, but shall be stowed in a separate magazine, if practicable.

(c) Small-arm ammunition shall be stowed in a separate magazine.

(d) Fixed ammunition in cases containing the primers, shall be stowed in separate magazines.

(e) Smokeless powder shall not be stowed in any magazine wherein the temperature is habitually above 95° F., or wherein the temperature ever reaches 100° F. If the temperature reaches 90° F., artificial means for reducing it shall be adopted.

(9) *Air in magazines.*—If the air in any magazine be at all impure, or if the odor of ether be noticeably strong in any magazine containing smokeless powder, such magazine shall be blown out by portable fans and otherwise ventilated.

(10) *Empty tanks.*—Empty cartridge cases, boxes, and powder tanks shall be handled and stowed with care and shall be turned

in at a naval magazine at the earliest opportunity. Cartridge cases must not be deformed by severe handling while still hot from firing, and as soon as practicable thereafter, they shall be thoroughly washed with hot water and soap, carefully dried, and repacked in the boxes in which they were supplied.

538. Tests and inspections.—

(1) *General.*—

(a) Navy smokeless powder being ether-alcohol colloid of nitrocellulose, cannot be held to possess unlimited chemical stability, and the length of its life depends very largely on the conditions under which it is stored. At temperatures approaching 100° F., the period during which it will retain stability sufficient to warrant its retention in service, is relatively short. Although chemical tests give an indication to the probable life of powder, no satisfactory method has been devised of foretelling with certainty its length of life. The only safeguard is, therefore, to discover loss of stability by frequent tests and such tests shall be made with unceasing care and vigilance.

(b) Officers charged with the care of magazines and the examination and tests of smokeless powder shall thoroughly familiarize themselves with the practical methods of making such examinations and tests; and they are held responsible for the accuracy thereof and for the correctness of the official reports thereon. In order that the tests may be of value, as indicating the stability of powder, it is essential that the methods in all details shall be uniform, and those charged with this duty must follow strictly the prescribed methods.

(c) The Bureau of Ordnance records all tests reported from the various sources and keeps careful records of the disposition and condition of each index, in order that proper steps may be taken, without delay, to dispose of any index which develops low stability. (In case of powder on the Asiatic Station, this duty has been delegated to the inspector of ordnance in charge of the chemical laboratory, Philippine Islands.) In order, therefore, that this system may be carried out, care is enjoined to submit correct and complete routine reports of ammunition on hand, stability tests, etc.

(2) *Routine.*—The following examinations and tests shall be made of smokeless powder on board ship:

I. *Daily.*—Visual examination of samples and tests of charges for local heating. Examination of violet paper.

II. *Fortnightly.*—Visual examination of one or more charges of each index.

III. *Monthly.*—66.5° C. "surveillance" test on all indexes that give a test of less than 30 days.

IV. *Bi-monthly.*—65.5° C. "surveillance" test on indexes giving 30 to 39 days' test.

V. *Quarterly*.—65.5° C. "surveillance" test on indexes giving 40 to 59 days' test.

VI. *Semi-annually*.—65.5° C. "surveillance" test on indexes giving 60-day test or more.

I.

(3) *Daily examination*.—

(a) The daily examination shall be made as a part of the daily magazine inspection required by these instructions. With ammunition received from naval magazines, there will be supplied a sample of each index, which will be contained in a glass bottle with tight glass stopper. The different samples shall be stored in the racks provided, in the same magazines with the indexes which they represent, and shall not be opened, except for the purpose of conducting the violet paper test hereinafter provided for. The samples shall be daily examined in a good light, without removing stopper, to note whether the powder retains its normal appearance. The presence, at any time, of reddish or orange-colored fumes in the bottle will indicate the decomposition of the powder.

(b) Since advanced decomposition of powder is often accompanied by heat, several charges of each index shall be examined daily for evidence of heating by laying the bare hand on the surface.

II.

(4) *Fortnightly tests*.—

(a) The powder in one or more charges of each index shall be visually examined fortnightly for signs of decomposition or change in appearance. Different charges shall be selected from time to time for this examination, and after marking it, particular pains shall be taken to see that the tanks or cartridge cases, the contents of which are to be exposed for as short a time as possible, are restored to their former air-tight condition.

(b) The inside of a tank, case, or bag containing smokeless powder, which has been giving off the nitrous fumes, which accompany decomposition, will probably show a reddish or orange appearance. Upon first opening such a package the characteristic acrid and pungent odors of the nitrous fumes can be readily detected by smelling. Upon this point depends the main value of this examination, and the conditions upon first opening the charge should be carefully noted by applying the nostrils to the charge immediately after opening. The odor of ether is natural and is of small consequence.

(c) A small scoopful of the powder should be taken into a good light and examined as to its physical properties. Powder is of various colors, ranging from light yellow to dead black. Certain indexes have been dyed a bright red, which, in the course of time, will bleach; but this bleaching is not to be taken as an

indication of decomposition. Other varieties will change color, darkening from the original yellow to brown or black. This indicates a certain change, but does not indicate loss of stability or change in ballistic qualities. In general no notice is to be taken of the color or change of color, except that a very marked whitening of the grains, in connection with other indications, is to be considered as indicating loss of stability. The grains of decomposing powder will, in a measure, become soft, yielding to the pressure of the thumb nail, or crumbling easily.

III, IV, V and VI.

(5) *Violet paper test.*—

(a) Two types of violet paper are made. One known as normal violet paper has a very deep tint and is used in the laboratory when testing powder at a temperature of 135° C. The other is known as N/10 violet paper, and has a paler tint. It is this type which is issued to ships and magazines for testing powder at normal atmospheric temperatures.

(b) Powder being a nitrocellulose product is subject to decomposition, the rapidity of which is largely influenced by temperature. If powder could be kept at a low temperature it could be considered permanently stable. At 60° F. the decomposition is so exceedingly slight that powder could be stored for many years without difficulty. At temperature above 70° F. the rate of decomposition rises rapidly.

(c) The final result of such decomposition is the emanation of oxides of nitrogen, which if not immediately absorbed by stabilizers will be given off in the form of gases which then may attack anything like metal or cartridge bag material. These gases are strongly acid and have oxidizing properties and this fact is taken advantage of in the violet paper test. The coloring matter is decolorized by oxides of nitrogen. The coloring material is in definite amount and the paper carrier of the color, which, like cartridge bag cloth, will absorb a certain quantity of the oxides, is of standard size. The point to be determined is then the length of time (or in other words, quantity of oxides given off) to change the color from violet to white.

(d) If a sample of powder in only fair condition is subjected to this test, the length of time required to decolorize the paper will depend upon the temperature at which it is kept. If at a shore magazine during the winter months the paper may remain practically unchanged, but as soon as temperature begins to increase the rate of change may become more rapid. The object of this test is to supplement the surveillance test, to give warning of special vigilance necessary in examination of magazine samples by surveillance test.

(e) At shore magazines, where large differences in temperature are found in different seasons, special study is necessary to interpret results when these changes occur.

(f) Aboard ship, where temperatures are more constant, reliability can be assured, provided the conditions of the test are carried out. The same paper can remain in the sample bottle indefinitely so long as little change in color occurs. If a noticeable fading of color occurred in two months, the paper should be removed at the end of the two months period, and a new one substituted as though the test were just commenced.

(6) *Method of use.*—

(a) N/10 violet paper is for testing powder from rounds, charges, or bulk. It is used dry. The change of color is a gradual fading to a faint violet, then change to blue and finally total loss of color, leaving a white paper. It is not affected by acids other than oxides of nitrogen. It is only slightly affected by light, but it is recommended that all tests be carried out as little subjected to light as possible. It is not affected by ordinary handling.

(b) With serviceable powder, the paper will not become white in two months at ordinary temperatures. The following table will present some useful comparisons:

Powder sample.	Surveillance test at 150° F.	N/10 violet paper turns white.				
		At 64° F. in days.	At 70° F. in days.	At 100 F. in days.	At 110° F. in days.	At 150 F. in days.
6-pdr.....	7	217	67	12	3	2
6-pdr.....	21	400 plus	252 plus	39	13	2
8-inch/35 cal...	19	81	21	5	2	2
8-inch/35 cal...	48	334	220	12	7	3

(c) It might be supposed that it would be possible to use this paper in powder tanks or boxes, but such is not the case, because the oxides of nitrogen attack the metal and cartridge bag and increase the time of test so much as to make results unreliable.

(d) Each shipment of N/10 violet paper is accompanied by the following legend:

N. P. G. Form No. 86. 500 Strips Violet Paper for Testing Powder.

(e) When received, this paper must be transferred to tight glass-stoppered bottles and a copy of these instructions shall be pasted upon each bottle. The bottles should at all times be stored in a dark closet. To test powder from rounds, charges, or bulk: A portion of the sample is placed in a glass-stoppered bottle, preferably enough to about three-fourths fill a 16-ounce bottle. One strip of DRY paper, marked in pencil with the date of starting

the test, is dropped into the bottle on the powder and the bottle closed tightly. The bottle should be stored at approximately the temperature of the magazine from which the sample was taken and well protected from bright sunlight. The time of the test is the number of days required for the paper to become white. The bottle should not be opened during the time of the testing.

(f) Only one piece of this paper should be allowed in the test bottle at any time. Total loss of color should be checked by examination in good sunlight in comparison with compared standards. These standards may be prepared by holding strips of violet paper in red fumes formed by the action of dilute nitric acid on copper, or by exposing to the sun's rays a small quantity of small caliber powder in a bottle until a slight odor of nitrous fumes is noticed, and then dropping a strip of violet paper in the bottle. Graduations of loss of color may be obtained in this way and the sample strips retained without special care for future use.

(7) *Surveillance test.*—Whenever any index gives loss of stability in the daily or fortnightly examinations, it shall be subjected to the "surveillance" test.

(8) *How applied.*—The "surveillance" test shall be applied to one sample from each index every six months. The sample, of fifteen to fifty grams in weight, shall be taken from the broken charge and be in whole grains, the lesser weights being taken for the small caliber powders. It shall be placed in an eight-ounce salt-mouth glass-stoppered bottle, made tight by carefully grinding the stopper, and exposed in the 65.5° C. constant-temperature oven. The bottle must not be opened during the test. The end of the test is the first appearance of red fumes in the bottle, and the record to be made is the number of days in which it takes to develop these fumes.

(9) *Remarks on the "surveillance" tests.*—

(a) The routine tests shall be started on July 1 and on January 1, and the results shall be reported to the Bureau of Ordnance on the proper blanks at their completion. At the end of sixty days the test shall be discontinued, unless for particular reasons it is advisable to run it longer, and any index which does not give red fumes within this period is to be reported as "sixty-days." In any case where an index assigned to 5-inch 40-caliber or smaller guns gives red fumes in less than twenty days, or an index assigned to guns larger than the 5-inch 40-caliber gun gives red fumes in less than forty days, the results are to be immediately reported to the Bureau of Ordnance.

(b) The "surveillance" test is at the temperature of and has replaced the potassium-iodide "heat test." Noting the presence of red fumes in a bottle is much less liable to error and requires less experience than did the KI test, the use of which was discontinued on shipboard on account of the great diversity of the results obtained by inexperienced operators. The examination of

the bottles for red fumes shall be made once every twenty-four hours in a good light. The fumes, which will not be dense, but will be yellowish red, can best be seen by looking through the bottle at a white background. Should there be any doubt as to the presence of the fumes at the daily examination, the appearance should be carefully noted and a close examination made on the following day, when the additional twenty-four hours' exposure should have very considerably increased the depth of color. Upon the conclusion of the test, the sample shall be removed from the oven and thrown overboard, since it may explode if the test be carried too far.

(c) This test shall be conducted in the electrically-heated constant-temperature oven supplied for the purpose to all battleships, cruisers, torpedo tenders, and gunboats. Full directions for the operation of the ovens are supplied with each outfit, and sealed tubes containing nitrous fumes will be furnished as comparison tubes for determining the end of the test.

(d) Sealing wax should not be used on bottles. While results may be comparable among themselves, they cannot be compared with any other results where wax is not used. Further, if sealing wax is depended on, some powders have so much volatiles which become vapors at 65.5° C. that considerable pressure is developed and leakages are more likely to occur even through the wax.

539. Constant-temperature oven.—

(1) *Object.*—The object of this oven is to determine the length of time in which a given quantity of powder at a temperature of 65.5° C. (150° F.) when placed in tight, glass-stoppered bottles, will produce visible red oxides of nitrogen. A fume tube to show the appearance to be expected, and the point at which the time should be taken, is supplied with the oven.

(2) *Temperature.*—The temperature of the bottles enclosing the powder must be 65.5° C. plus or minus 2 degrees while they are in the bath. The allowance of 2 degrees is given for fluctuations which cannot be controlled, but it is expected that the average temperature will be held at 65.5° C. While the baths are supplied with an electrical control, set at a constant temperature and supposed to be in such a position that it will keep the proper temperature, checkage of the actual temperature of the powder must be made for the reason that the thermometer may be so placed with reference to the powder that the heat diffused from the bottom of the bath may reach bottles and thermometer unequally. The best way to test the actual temperature is to insert the chemical thermometer, supplied with the outfit, through the small hole in bath cover, with its lower end resting in and on the bottom of an empty bottle in the usual location of powder bottles. If the temperature is found to be greater than desired after the bath reaches constancy, it may be decreased by adjusting the height of the electrical thermometer, *i. e.*, in the square box

type, removing the bottom plate of the thermometer cage which is of wood and replacing this with a brass plate $\frac{1}{8}$ " or greater as desired. This brings the thermometer nearer the source of heat and allows quicker cut-off in the rising temperature, with lower temperature on powder as a result. Another way in which this may be accomplished to a less extent is the use of a wire mesh tray, the bottom of which may be raised or lowered by varying the foot pieces. This tray may be in four sections with handles and will allow much quicker observation of samples and less cooling effect in the bath.

(3) *Bottles*.—Eight ounce, salt mouth, "Non-Sol" glass stoppered bottles, thoroughly washed and dried, must be used. This type of bottle has a peculiar pale yellowish-green color which makes it clearly distinguishable from any other glass bottle known, and is manufactured by the Whitall Tatum Co., Millville, N. J. The stoppers, however, are of ordinary glass. The etched space on the bottle serves for the pencil marking of sample and date of commencing and ending test. Each bottle should have its stopper ground in carefully with fine emery and a solution of camphor and turpentine, each stopper then being secured to its bottle by a string, but this string must not be used to tie down the stopper while in use.

(4) *Samples*.—The samples will be made up of whole grains of powder, without unnecessary exposure to air, and will weigh 45 grammes for all calibers except the 10-inch 40-caliber and above; five whole pieces of those calibers will be used. The designation of the powder, and the date when put in the oven, should be written in pencil on the etched space near the bottom of the bottle. The bottles are to be examined each day in a good light, against a white paper background, for fumes, the earliest development of which is like the standard tube furnished. With small caliber powders not in excellent condition the fumes develop rapidly, and on the day after the first indication of the test should be unmistakable. It is recommended that small caliber powder, like the 1-pdr., be not kept in the oven after the first indications of fumes, as such powders, under favorable conditions, might ignite spontaneously, though no case has occurred with the larger calibers. The test is completed and the bottle withdrawn from the oven when the development of red fumes is certain.

(5) *Equipment*.—

(a) The equipment consists of a heat insulated oven with electric heating element,

(b) A mercurial control in the central part of bottle chamber,

(c) A relay with two dry cells, attached to oven and protected by a wooden cover,

(d) Two rheostats which are connected properly to the oven,

(e) A special graduated thermometer with cork support.

(6) *Installation.*—

(a) To install the oven, connect the circuit of the proper voltage to the binding posts of the rheostats to which the red and black covered cable is already attached. See that all connections of mercurial control, relays, batteries and rheostats are tight.

(b) This oven has two sets of heating coils, the one connected to the red covered cable having the lower resistance (high heat), the other connected to the white covered cable having the higher resistance (low heat). The black covered wire being the common connection, this cable should be connected to the line and rheostats.

(7) *Operation.*—The temperature of the oven is controlled by a mercurial control device which is placed in the center of the oven. The operation is as follows:

(a) When the oven heats up to 65.5° C. (150° F.) the mercurial control automatically closes the battery circuit which in turn switches on the coils giving low heat. The heat then gradually decreases and the control automatically short circuits this high resistance winding by means of battery circuit, and switches on high heat. By adjusting the high and low heat by means of rheostats, very close results can be obtained. It has been found that the best results were obtained when high heat was set at 112 watts, and the low heat at from 55 to 60 watts for the 99-bottle oven; and high heat 60 watts and low heat 30 watts for the 24-bottle oven, at room temperature, from 23° C. to 26° C. (The 24-bottle oven is for use on board ship. The 99-bottle oven is for use at naval magazines.)

(b) Always run the oven 24 to 48 hours full of empty sample bottles at approximately the above wattages to dry it and to obtain constant conditions before inserting the specially graduated thermometer, after which the wattage can then be adjusted by means of the rheostats, so that the variation in temperature will not exceed one degree normal on the 24-bottle oven and two degrees from normal on the 99-bottle oven. Care must be taken after each adjustment to allow sufficient time to elapse, thus insuring constant temperature conditions throughout the oven.

(c) Great care should be taken to protect the oven against any fluctuations of room temperature. The dry cells will deteriorate with use and should be inspected from time to time, replacing by new ones when necessary.

(d) A spare coil is furnished. The resistance of this coil is correct for the outer section of the heating element; for the other sections, its length should be proportionately decreased. As the heating element operates at a very low temperature, there is very little likelihood that it will give trouble. The cover can be rigged with a counter balance so that it can be moved easily.

540. Decomposition of powder.—*Powder shall not be destroyed unless it shows unmistakable signs of advanced decomposition.*

(1) *Evidence of decomposition.*—In the event of such deterioration every charge of the index on board shall be examined, and only such charges will be destroyed as contain the decomposing powder. Decomposition in the sense here used is evidenced by—

- (a) The grains being friable and easily crumbled,
- (b) Unmistakable odor of nitrous fumes,
- (c) Very low litmus-paper and surveillance test.

(2) *Soft or mushy.*—Powder found to be in a soft or mushy condition shall be thrown overboard immediately.

(3) *Samples to be preserved.*—Whenever any powder is landed or destroyed because of its unstable or decomposed condition, samples of each index shall always be preserved and forwarded to the Naval Proving Ground for examination, and the Bureau of Ordnance notified at once of the shipment and the reasons therefor.

CARE AND HANDLING OF TORPEDOES.

541. In time of war.—

(1) *General instructions.*—When action may present itself, even though not imminent, all torpedo tubes should be kept loaded, torpedoes ready for immediate use, with war heads attached and air flasks charged to full working pressure. Governors are to be blanked off. Submerged tubes should be kept free of water. If, through unavoidable leakage, it is impossible for a tube to be kept dry, the torpedoes should be shifted daily to prevent rusting. The tubes should be kept cleared for instant action, and all necessary precautions taken to prevent premature discharge of torpedoes. The spare torpedoes should be at hand fully prepared for use; with war heads on, air flasks charged and dry primers in place. It is discretionary with commanding officers as to whether, until the spare torpedoes are actually required for use, their war noses and detonators shall be placed in the war heads.

(2) *Air flasks.*—All air flasks should have the air pressure verified daily, and decrease due to leakage made up. A reasonably tight flask should not lose more than 100 pounds pressure in 24 hours.

(3) *Accumulators.*—All accumulators should be habitually kept charged to full pressure.

(4) *General preparations.*—All preparations requiring considerable time should be undertaken at *general quarters*. Such general preparations should include:

- (a) Starting air compressors and draining separator.

(b) For submerged tubes, getting a second torpedo adjusted and trolleyed as close as possible to its tube.

(c) For deck tubes, if spare torpedoes are provided, they should be adjusted and trucked to a convenient location near the desired tube.

(d) The adjustments referred to above should have to consist only of final touches to the war nose, putting tension on regulator springs, opening stop valves, inserting pistons, opening fuel valves, locking gyros and removing propeller locks. The transportation screw is advisable, but is not absolutely necessary if any degree of care is exercised in handling torpedoes.

(5) *Loading*.—For each ship, and frequently for each tube, there exist peculiarities due to local conditions. For handling torpedoes, the loading drill must, therefore, be worked out to suit the existing circumstances in order to secure rapidity of fire.

(6) *Propeller locks*.—Propeller locks must always be kept lashed in place until the torpedo is in the tube.

(7) *Records*.—Instructions in record book must be followed.

542. Care of torpedo on board ship.—

(1) *General*.—Constant supervision must be exercised to insure torpedoes being at all times protected from grit and that they are kept clean, externally and internally. The outer surface of shells and flasks must be frequently inspected and kept protected from rust. A heavy oil or vaseline is the best lubricant for this purpose. The inner surfaces of Whitehead afterbodies, of all steel tails, of all steel parts of immersion and buoyancy chambers, and exteriors of all flask bulkheads must be painted with red lead as protection against corrosion. The inner surfaces of Bliss-Leavitt afterbodies must not be painted, but must be protected by oiling. No bronze part of any torpedo shall be painted. All interior parts must be kept in thorough working order and well oiled on working surfaces. Never apply fresh oil to a working surface without first removing old oil, as old oil may contain grit. Valve and air joints must be kept free from grit and dirt and from deformations in handling. Steel screws, shell plugs of various kinds, vertical vanes, rudder connections and other steel parts are to be protected from rusting by lubricants. Joint screws, stop valves, charging valves, shell plugs and external steel screws must be periodically turned to prevent rusting. Depth index, regulator and distance gear springs must not be kept in compression for an undue length of time, else a permanent set will be taken. The shell, tail and head must be protected from injury by blows or violent handling. Regulator, charging, stop, starting valves and steering engines are to be disassembled, cleaned, oiled and reassembled at least once a quarter.

(2) *Lubrication*.—For external lubrication sperm oil makes the best appearance, but does not protect so well as a heavy oil

or vaseline. The use of emery cloth must be reduced to a minimum. Care must be taken to avoid working the shell thin and getting emery dust in the working parts.

(3) *Handling*.—In handling torpedoes the strain in lifting must always be applied to the air flask and never to the shells of the heads, buoyancy or immersion chambers, or afterbodies. In handling torpedoes in brackets or on trucks or chocks, the weight must be taken under the air flask, care being taken to never allow a torpedo to rest on the tail for even an instant.

(4) *Tail and propellers*.—The tail and the propellers are the sensitive parts of the torpedo. Any undue strain on the frame of the tail or on the rudders may spring these parts out of line causing binding of delicate parts and destruction of accuracy. The propellers must not be even slightly bent, as a deformed propeller causes a torpedo to take a permanent heel during its run, allowing a component of the horizontal rudders to act in the vertical plane. It is a wise plan to frequently try propellers on the former block to detect unsuspected deformations. Care must be exercised in turning a torpedo about its axis not to exert force enough to twist the tail.

(5) *Use of oil*.—Oil is destructive of rubber. Care must be taken that the two do not come in contact.

(6) *Turning over by hand*.—Before admitting air to a Whitehead engine it should be turned over by hand to work out any accumulation of oil. Neglect of this precaution may result in a cracked or sprung casting or engine parts, or the blowing out of one or more valve chest or cylinder plugs.

(7) *Gyro leads*.—Care must be taken to blow gyro air leads free from oil and dirt before installing gyro.

(8) *Loading*.—In shoving the torpedo home into the tube, use a rammer placed against the end of the shaft. The tails of many torpedoes droop slightly when not water borne and allow the shoe on the bottom of the tail to take against the rear face of a deck tube, preventing the torpedo being pushed home. If the drooping is slight the best remedy is to file enough metal off the tube in wake of the shoe to give a slight incline up which the shoe can ride. If the droop is considerable, a rammer having a tip which can be inserted in the exhaust is used to lift and shove at the same time. To haul a torpedo out of a tube, use a tail line hooked around the afterbody just forward of the tail blades.

(9) *Propeller lock*.—The propeller lock is habitually to be kept shipped on an after propeller blade and brought in contact with the forward propeller blade whenever the torpedo is out of the tube, whether the flask is charged or not, except when actually removed for carrying out tests. It should be removed from a torpedo just before the tube door is closed and replaced when the door is opened in case a torpedo is to be withdrawn. Care

should also be taken to shift the propeller lock to an upper blade when a torpedo is inverted. Instances have occurred when the air in an uncharged flask has been so expanded by rise in temperature as to give sufficient pressure to turn the propellers. The precaution of shipping the propeller lock insures against injury to the person should the propellers be accidentally revolved. In recovering a torpedo by boat or diver, the propeller lock should be shipped as soon as the torpedo is reached.

(10) *Lowering.*—Torpedoes must not, except when absolutely unavoidable, be sent through the hatches with the air flask charged.

(11) *Charging and cooling air flasks.*—

(a) Torpedo air flasks shall be charged slowly to the full working pressure, and be allowed to cool naturally by air cooling. Loss of working pressure shall be made up just previously to firing.

(b) The artificial cooling of torpedo air flasks after charging, by spraying with water or by flooding the torpedoes in submerged tubes, is prohibited.

(c) Torpedoes fitted with removable flask heads shall have such heads removed after each practice. The interior of the flask shall be cleaned, dried and given a light coat of linseed oil.

(d) Any cutting of torpedo air flasks, accumulators, piping, compressors or other receptacles for compressed air used in connection with the torpedo plants is prohibited.

(12) *Examination of flasks.*—Examination of torpedo flasks in storage has shown many to be rusty inside, due to moisture carried in by the air charge admitted for final testing for tightness after closing. Flasks or torpedoes having removable bulkheads should be inspected and cleaned inside at least once a quarter if the torpedo has been charged since the last examination. In all cases after a torpedo has been run, the flask must be examined and cleaned inside before laying the torpedo up. The following method is found advisable: Remove head and wire brush inside of flask. Brushing can best be accomplished with a long handled weighted brush, using lye water if necessary. Care must be exercised that the seat for the head is not scratched or abraded during the cleaning. After freeing flask of all dirt and rust, examine for pitting and corrosion. Then apply one coat of boiled linseed oil with a clean paint brush. Allow flask to stand open for at least 24 hours to give oil coat a chance to thoroughly harden. Before replacing head the greatest care must be exercised to see bearing surfaces and screw holes of both seat and head are absolutely clean. For wiping them a clean rag is preferred to waste. In replacing head, set up on screws about half way, then charge flask to about 500 pounds pressure, and it will usually be found that the head will fit in its own seat, after which set up as uniformly as possible on all

screws. If no leaks are apparent, charge flask to 2250 pounds and allow to stand for 24 hours. The drop in pressure during that time, due to ordinary cooling, should be about 150 pounds. A larger loss will indicate a leak which must be located and repaired. In case it is found necessary to grind in a head, use a mixture of oil and flour of emery or finely ground glass on the seats of head and flask. The necessity of grinding in a removable head is usually due to setting up on securing screws hastily or unevenly. In blowing down flasks care should be taken that the air is allowed to escape gradually.

(13) *Air leaks in immersion chamber.*—Many cases of deep running and striking bottom are due to leaky after bulkheads or other air leaks in the immersion chambers. Special care must be taken to guard against and remedy such leaks. Charging flasks, or blowing down too quickly, or using water to cool warm flasks, are prolific causes of leaks in the after bulkheads. Care must be taken to avoid such practices. To obtain a full air charge, a flask should be allowed to air cool and then be brought to working pressure.

(14) *Oil cups.*—Keep oil cups full at all times.

(15) *Power plant.*—Turn power plant over by hand at least six turns daily, and by air at least for five minutes once a month.

(16) *Rudders.*—Move horizontal and vertical rudders at least six full throws daily.

(17) *Flasks.*—Except in time of war, flasks shall be habitually kept uncharged, other than where necessary in preparation for firing.

543. Tests and adjustments.—

(1) See that the flask is free from water.

(2) See that the setting of the depth index corresponds to the required pressure on the hydrostatic piston.

(3) Occasionally the flange of a Whitehead hydrostatic piston is sprung by the improper use of the forcing screws. This fault throws the pendulum out of the perpendicular when the torpedo is level, consequently adjustments made with tool No. 36 in place will give a false test of horizontal rudder throws. Should a torpedo run erratically in depth, and no fault can be found, the torpedo should be taken ashore, levelled and the adjustments checked with and without tool No. 36 in place. If the two tests give the same results, the pendulum is not out of line.

(4) See that all working parts are free from verdigris and well oiled.

(5) See propeller lock in place, throw back starting lever, crack stop valve and examine for leaks.

(6) Examine spindle of hydrostatic piston for verdigris. It must be perfectly clean and well lubricated, as a spot of verdigris on the working part has been known to cause an erratic run for depth. The piston must be square on its rod.

(7) Horizontal steering engines, especially that of the Mark II, require careful testing to see that they function properly. The Mark II horizontal steering engine is to be replaced by a more efficient type as the torpedoes become available.

(8) Spin the gyro in place, and see that the full rudder throw is obtained.

(9) In testing both horizontal and vertical rudder throws, have the torpedo slung. The steering engines must exert force sufficient to start and throw the rudders when opposed by the grip of a strong man.

(10) Particular care must be taken to see that steering lines do not bind.

(11) The exhaust valves and shaft packing of Bliss-Leavitt torpedoes must be tight, otherwise the afterbody will fill with water in a submerged tube and cause a cold shot, or it will fill after a run and cause the torpedo to sink. The shaft packing must be kept soft as well as tight, else the torpedo will take a heel.

(12) The hydrostatic piston face, which bears against the immersion chamber diaphragm, should be smoked as a precaution to prevent sticking to the piston.

(13) Other tests should conform to instructions laid down in the descriptive pamphlets and guide cards for the various Marks of torpedoes.

(14) A torpedo that has been laid up for some time should always be broken down and gone over before being fired.

(15) Remove all lost motion from rudder connections and be sure securing screws are set up tightly.

544. Exercise run, preparations.—

(1) See exercise head filled to required weight.

(2) Have torpedo well slushed before placing in tube.

(3) Be sure fuel pot is entirely filled, leaving no air space.

(4) Exercise care in locking B.-L. gyros Mark IV, Mark V, and Mark V Mods. 1 and 2, to insure the clutch being properly engaged and locked the proper number of teeth. The gear should lock easily and require no forcing.

(5) Always lock the gyro with door off, then put door on.

(6) Before putting a fuse in a B.-L. pistol, shake the part containing the plunger. The thumb should feel the firing point when shaken down, and the spring should return the plunger to its normal position.

(7) Always insert a pistol after the stop valve is opened. Slush the pistol with heavy oil before entering.

(8) See that sinking valve is not set to operate.

(9) Make tests and adjustments as called for by record book, descriptive pamphlet and guide card.

(10) Always keep torpedo upright after opening fuel feed valve.

(11) Guard starting lever with great care. A good method is to use a wooden wedge behind it. Wedge to be connected by a lanyard to propeller lock, so that both must be removed if one is.

545. War shot, preparations.—

(1) Carry out tests and adjustments prescribed by record book, descriptive pamphlet and guide card, and such of the preparations enumerated under *exercise run* which apply equally well to a war shot.

(2) Set sinking valve to operate.

(3) After torpedo is in tube, remove safety pin, etc., from war nose.

(4) An anti-circular run device is projected which, when in service, will require setting as one of the preparations for a war shot.

546. Recovery after firing.—

(1) *Boats*.—The recovering boats should be instructed to exercise the greatest care in picking up torpedoes. The boat must not bump any part of the torpedo, particularly the tail. A good plan is to provide steamers and power boats with a spar or frame work outriggering about three feet over the stern. The nose line is led through a crotch in the after end of the outriggering. Should the boat be backed with a torpedo in tow, the propeller cannot then strike the torpedo until the latter has swung almost entirely around.

(2) *Outfit for boats*.—All recovering boats should be provided with propeller locks, nose lines, buoys, buoy anchors and anchor lines.

(3) *Picking up torpedo*.—On reaching a torpedo, go alongside to leeward, taking care not to damage the torpedo; then:

(a) Put on propeller lock and lash same in place.

(b) Nothing else should be touched in order that all possible evidence will be available for diagnosis when received on board. Do not remove any foreign matter which may be foul of tail. Diagnosis is important whether run has been normal or otherwise.

(c) Attach the nose line (a bent iron hook is better than the brass pin provided), and tow back to the ship.

(d) Come alongside against the tide.

(4) *Handling alongside*.—When alongside put on hoisting strap at center of gravity, a tail line and a nose line from deck for steadying purposes; hook on whip and hoist clear of water. If torpedo does not balance, lower and shift strap (if wire one is used).

(5) *Hoisting*.—Hoist torpedo on deck, tending nose and tail lines carefully to keep torpedo clear of ship's side. Lower on truck or chocks, carefully examine torpedo to determine whether

or not all parts have functioned properly; then (on Whiteheads) close stop and fuel feed valves, remove fuse holder and gyro, being careful to get no water on the latter. Take remaining pressure. See that a small amount of oil is in oil cups, take off propeller lock, crack stop valve and allow engine to run slowly until all parts are lubricated and afterbodies and exhausts are clear of water, giving flask a light charge if necessary. Then blow down flask if torpedo is not to be used soon. Lock pendulum and strike torpedo below or take to place for overhauling.

(6) *Care after run.*—Wipe water off shell and flask immediately, and give a coat of oil or vaseline. Drain immersion chamber and afterbody, relieve pressure on all springs and oil all parts liable to set, or rust, or corrode, particularly all steel screws and the rudder connections in tail.

(7) *Inspection after run.*—When a torpedo has made a run it should be critically examined and tested in all its parts to see that everything is in good condition. Should a torpedo have made a bad run, the fault must be located at once and the torpedo must not be fired until the fault is definitely located and corrected.

(8) *Procedure before laying up.*—If the torpedo is to be laid up, empty water from exercise head, examine to see if it is tight, remove bulkhead, dry out interior and touch up rusty spots with red lead. Break down the torpedo, thoroughly clean and lubricate all parts, assemble and test out.

547. Repairs on board ship.—

(1) Torpedo repairs on board ship should be undertaken by none but skilled men. Faulty and careless repair work is sure to have disastrous results.

(2) Great care must be taken that parts are not deformed by squeezing in a vise.

(3) The parts of two or more disassembled torpedoes must be kept separate.

(4) It is essential that where two bearing surfaces of rotating parts come in contact they be made of different metals.

(5) A new regulator spring cannot, except by chance, be installed and used with the old adjustment. With the facilities on board ship, the best method of getting the new adjustment is to run the torpedo over a carefully measured range of full distance to obtain proper speed.

(6) Slow speeds are frequently caused by a very slight binding or friction in the propelling mechanism, due to adjusting with too small clearance or to improper lubrication or to expansion by heat.

(7) The turbine clearances are important. Slow speed may be caused by either too much or too little clearance.

(8) A binding turbine will cause the torpedo to roll.

(9) Valves should never be ground in with emery, as it changes the parts and causes continued wear. Use the finest available grinding substance. Powdered pumice stone is good.

(10) Two parts should never be lapped into each other. They should be lapped with male and female laps. Before attempting to enter one part into the other, carefully wipe off all lapping substance and cover with oil.

(11) In case of a broken connection, never use solder where parts were formerly brazed.

(12) Small holes in a torpedo shell may be closed by a steel rivet, well soldered after it is clinched. Larger holes can be closed by a piece of sheet metal, conforming to the shell contour, being riveted and soldered on the inside. All rivet holes should be beveled on the outside so the rivets can be filed flush with the shell.

(13) Gaskets and washers in the washer boxes are supplied for replacing those which become defective through accident or age.

(14) Solder will usually stop a leaky porous casting.

(15) Care must be taken to have all lost motion removed from rudder connections.

(16) One or both sides of a rudder gasket should be covered with graphite (no grease) in order to be able to break a joint without injury to the gasket.

548. Faults and remedies.—Each Mark of torpedo has its own inherent faults. These and the remedies for them will be found described in their respective descriptive pamphlets.

549. Miscellaneous.—

(1) In torpedoes which have lead weights permanently soldered in the immersion chambers, the latter should occasionally be removed and replaced after the metal of the shell has been cleaned and painted. Removable weights should be more frequently taken out.

(2) When charging flasks with removable bulkheads, a sharp crack is sometimes heard. It means nothing but that the head has shifted slightly on its seat.

(3) One thousand (1000) yard range plugs are no longer issued with Whitehead torpedoes.

(4) Pistols should be carefully cleaned after use.

(5) Propellers must be matched, *i. e.*, blades of the forward and after propellers should come in the vertical axis of the torpedo at the same time. The torpedo will roll if they are assembled otherwise.

(6) Critically examine starting levers to see that they are not bent or worn.

(7) Experience shows that for the 4000-yard setting the water tripper should be adjusted so as to just not permit the engine to turn over until the water tripper goes down. More certain action of the fuse results.

(8) Bliss-Leavitt gyro mechanisms should be stored outside their torpedoes.

(9) Torpedoes stored outside of tubes should have all openings in the shell closed by canvas coverings.

(10) Light oil (sperm) should always be used throughout a torpedo when a cold run is to be made. It must be drained from all oil cups before filling them with heavy oil.

(11) Frequently superheater failures are due to dirty fuel or dirty fuel strainers. Care will avoid failures from these causes.

(12) Particular attention should be given to insure that steering engines are absolutely free from dirt.

(13) Engines must be frequently turned by hand.

(14) Freezing of water in exercise heads and in steam torpedoes must be guarded against.

(15) Should a torpedo be started in a submerged tube before the tube is flooded, the damage may be lessened by flooding the tube. If possible to do so, eject the torpedo.

(16) Hold up the tripping latch until the guide stud takes against the stop bolt; then see that the tripping latch returns to its place.

(17) Crossed threads must be guarded against most carefully, particularly in Bliss-Leavitt charging valves. No Bliss-Leavitt torpedo now in service is fitted with a bushing in the charging valve; consequently, when the threads are destroyed the whole casting is rendered useless.

(18) Many Whitehead depth troubles are caused by carelessness in locking. Always bring the jaws fair with the locking bar by moving the rudders; never apply force. The locking bar has sufficient leverage to bend the parts by applying only a little force to the locking tool.

(19) In those spray valves which have a worm to create the spray mechanically, the outer diameter of the worm must be a lap fit in the spray body. If not, a too rapid delivery of fuel will generate sufficient heat to damage the engine, the reason being the friction of the fuel passing around the worm has a great effect on the quantity of fuel delivered, regardless of the size of the opening in the spray nozzle.

(20) In all other types of spray the size of the spray orifice governs, within a moderate range of pressure, the rate of fuel delivery; consequently, it is necessary that these openings be kept clean and that they be not cleaned with any material or metal instrument which will alter their size.

(21) The fuel flask should always be drained after a run, as it may contain water. Fuel itself should be critically examined to make sure that it contains no water or dirt. Water in kerosene can be removed by letting it stand to settle and then straining it through chamois.

(22) The use of short hot runs with gyro is recommended as being the best and quickest way of tuning up and testing torpedoes. By running over an accurate 1000-yard range (and 1000 yards can be measured with the means at hand much more accurately than 4000 yards), carefully measuring air, fuel and oil consumption, a very good measure of a torpedo's condition can be obtained. Better data can be obtained at 2000 yards and final results at the full range, but the long ranges should not be taken up as long as there is still more to be learned at the short ranges. The advantage of the short range running lies in the smaller risk of loss of torpedo, as it can be fired with positive buoyancy, and also a greater number of shots can be fired without overhauling a Whitehead engine.

(23) A Whitehead engine in good condition can be depended on to make three 4000-yard hot shots without overhaul. A good method to follow after blowing the oil and water clear of the engine is to pour one-half pint of sperm oil into the combustion flask through the fuse holder body, then turn the engine over by air until thoroughly lubricated by the sperm oil.

(24) Before sending a torpedo to the Torpedo Station, it must be thoroughly cleaned and oiled inside and outside. Torpedoes have frequently been turned in with the following easily prevented defects: Rusty exteriors; fuel in fuel flasks; water, dirt and oil in afterbodies; water in immersion chambers; inside of air flasks rusty; water in air flasks; tail gearing full of mud.

(25) Look ahead in making requisitions for spare parts and supplies. Too great a supply on hand shows judgment as bad as is exercised in having too small a supply.

(26) It should be remembered that erratic depth performances are frequently due to (a) regulator troubles causing fluctuation in speed; (b) torpedo not upright, due to (1) alterations in weight, (2) unbalanced propellers, (3) unbalanced friction; (c) torpedo rolling on account of heavy air leaks.

(27) When not required for practice, keep exercise heads empty and interiors painted to prevent rusting.

(28) Many immersion gears have a small hole in the bulkhead under hydrostatic piston. This hole is to relieve air which might otherwise bank up under the rubber diaphragm, causing weak operation of piston.

(29) In using pendulum adjusting stand, put scale on zero and level stand with adjusting screws. For Whitehead pendulums use a level on the machined face of hydrostatic piston trunk. For Bliss-Leavitt pendulums use a bevel protractor level on machined face of diving gear. The stand must be leveled in two planes.

(30) Small lines should be spliced in eyes of propeller locks.

550. Notes on gyros.—

(1) In testing gyros the following are important:

(a) It is impossible to properly test a gyro if there is water or oil in the air lines.

(b) Air pressure used in testing gyros must be of the proper amount, 300 pounds for Whitehead and 400 to 425 for Bliss-Leavitt. There should be a pressure gauge at the gyro stand to show whether or not the proper pressure is being given.

(c) In torpedoes, the gyro reducing valves must be set to give the gyros the same pressure as that with which it was tested.

(2) Air leaks in the afterbody which produce draughts in the vicinity of the gyro are destructive of accuracy.

(3) Too loose adjustment of gyro wheel bearings will cause vibration of valve mechanism.

(4) Foreign matter on valve plugs when put in frames of Mark I Mods. 2 and 3, Mark II Mod. 2 gyros, will cause a great deal of trouble in testing and will give weak action of steering engine.

(5) Steering engine pistons in all gyros should be a good fit in order that proper power may be delivered.

(6) An air leak by a control valve will cause trouble.

(7) A small defect frequently causes great trouble in getting a gyro in adjustment. Some of these defects are:

(a) Small pits or flats, due to rust or wear on balls, cups, pivots or ball races.

(b) Worn pivots or bearings.

(c) Wheel slightly out of line.

(8) Bliss-Leavitt cup ends, if not worn too deeply, can be ground true on a flat surface. If worn too deeply, turn the cup end over and use the other side.

(9) Upper pivot in outer gimbal ring should be a good fit. If too loose a fit, it will cause gyro to give a poor test, sometimes creeping right and then, without change of adjustment, creeping left. The fit of lower pivot is not so important.

(10) Vertical rudder throws should be equalized with gyro in place, even though experience has shown a torpedo will steer if rudder throws are unequal.

(11) Whitehead gyros are always shipped broken down, and Bliss-Leavitt assembled with paper well stuffed between wheel, gimbal rings and carrier.

(12) When testing a gyro which has been laid up, do not accept the first two or three cards. Wait until all stiffness has been worked out of the gyro before making any change in the adjustments.

(13) Keep gyros in a dry place, free from vibration. Spin wheels by hand at least once a week. Occasionally put a drop of oil on each bearing.

(14) If a gyro has been wet, immerse it in alcohol or gasoline, and then *immediately* disassemble, thoroughly drying and oiling all parts.

(15) Carefully inspect and oil a gyro as soon as removed from a torpedo.

(16) All gyro spare parts must be kept well greased, free from rust and be frequently inspected.

(17) In adjusting gyros on board ship, considerable success has been attained by building a mount over a binnacle on which the adjusting stand is mounted and kept oriented by means of the compass.

(18) The following table gives the various marks of torpedoes and numbers of Bureau of Ordnance pamphlets descriptive thereof:

TORPEDOES IN USE IN THE U. S. NAVY AND THEIR PRINCIPAL CHARACTERISTICS.

Type.	Mark.	Mod.	Length.	Diam.	Speed, knots.	Effective range, yds.	Full air charge, lbs.	Wt. run cot- ton charge, lbs.	Descriptive pamphlet No.	Wt. of tor- pedo ready to fire.	Gyro gears.			Descrip- tive pam- phlet No.
											Mark.	Mod.		
Howell	I, II, III	I	11' 13"	.....	.....	.....	.....	.....	Obsolete	.....	.....	.....	.....	Obsolete
W.H.....	I	I	3.55 m.	45 cm.	27.5	1000	1350	220	317	1101	I	1	.....	322
W.H.....	II	.....	5.00 m.	45 cm.	27.5	1500	1500	132	317	1220	I	1	.....	322
W.H.....	III	.....	5.00 m.	45 cm.	20.0	860	2250	132	.....	.....	II	2	.....	.....
B.L.....	IV	.....	3.55 m.	45 cm.	30.0	2000	2250	138	338	1547	IV	3	.....	375
B.L.....	V	I	5.00 m.	45 cm.	29	3000	2250	200	.....	.....	IV	3	.....	449
W.H.....	V	.....	5.20 m.	45 cm.	27-40	1000-4000	2100	200	323 & Ed.	1547	II	2	.....	322 & 323
W.H.....	V	.....	5.20 m.	45 cm.	29-40	1000-4000	2100	200	323 & Ed.	1452	I	2	.....	322 & 323
W.H.....	V	2-3	5.20 m.	45 cm.	29-40	1000-4000	2100	200	323 & Ed.	1452	I	2	.....	322 & 323
W.H.....	V	4	5.20 m.	45 cm.	29-41	1000-4000	2150	200	323 & Ed.	1452	I	3	.....	322 & 323
B.L.....	VI	.....	5.20 m.	45 cm.	30	3000	2250	200	365	1536	VI	.....	.....	365
B.L.....	VII	.....	5.20 m.	45 cm.	32	4000	2250	200	436	1540	VII	.....	.....	436
B.L.....	I	2	5.00 m.	21"	26	3500	2250	180	320	1900 Dis.	IV	.....	.....	320
B.L.....	II	I	5.00 m.	21"	26	3500	2250	180	331	1900 Dis.	V	1	.....	361
B.L.....	III	.....	5.00 m.	21"	26-28	3500	2250	318	363	1928	V	2	.....	375
B.B.L.....	VIII	.....	21 ft.	21"	26-28	10000	2250	300	.....	.....	VIII	.....	.....	.....
B.B.L.....	IX	.....	5.00 m.	21"	27	7000	2250	200	.....	.....	VIII	.....	.....	.....

GUN COTTON AND TRINITROTOLUOL.

551. Gun cotton.—

(1) *Description*.—Gun cotton is known as dry or wet gun cotton, the latter being simply dry gun cotton with 25% of its weight in pure distilled water added.

(2) *Properties*.—Dry gun cotton is more sensitive than wet and is more liable to decomposition. Wet gun cotton, when detonated, is equally as powerful an explosive as dry, but it can be detonated only by the explosion of dry gun cotton in immediate contact with it. Dry gun cotton can, on the other hand, be exploded by a charge of fulminate of mercury.

(3) *Wet gun cotton*.—Hence, for reasons of safety, all charges of torpedoes, mines, countermines, wrecking outfits and all gun cotton carried in bulk is kept wet, the required weight of moisture being 25%.

(4) *Dry gun cotton*.—Dry gun cotton is carried on board only in primers for the wet charges; when these primers are used, some of the blocks of wet cotton are dried as described below.

552. Specifications for manufacture.—The following are the latest specifications for the manufacture of gun cotton for the U. S. Navy:

(1) *Nitration*.—All gun cotton is to be of the maximum possible nitration, containing in no instance less than 13.2% of nitrogen.

(2) *Density*.—All blocks are to have the maximum density possible, but in no case less than 1.3% when containing 25% of moisture; or the weight of a cu. in. of dry gun cotton, when pressed into a block, shall not be less than 0.6 ounce.

(3) *Purity*.—The gun cotton is to be washed free from the alkali used in its purification. No carbonate of soda or other alkali is to be added to the finished pulp. The addition of mercuric-chloride solution to the gun cotton is also forbidden.

(4) *Heat test*.—The gun cotton shall stand a heat test at 65.5° C. for forty minutes without showing signs of decomposition.

(5) *Packing and delivery*.—The gun cotton, containing 25% moisture, is to be delivered f. o. b. cars at the works of the manufacturer, packed in zinc-lined wooden boxes, with covers fitted with rubber gaskets to make boxes airtight, and to be of convenient size.

(6) *Sizes of blocks*.—The gun cotton blocks shall be pressed into the following sizes as the Bureau may direct:

(a) For naval defense mines Mark I and wrecking mine charges in blocks 2.9 x 2.9 x 2 inches, without central perforation.

(b) For torpedo war heads and for Mark II and Mark II Mod. 1 naval defense mines, charges in blocks $8\frac{1}{2} \times 8\frac{1}{2} \times 2$ inches, without central perforation.

(c) Primers for Mark I, Mark II, Mark III Mod. 1 naval defense mines, wrecking mines and countermines charges in blocks $2.9 \times 2.9 \times 2$ inches, with $\frac{1}{8}$ inch central perforation piercing the 2.9×2.9 faces of the block.

(d) Primers for torpedo war heads in cylindrical blocks, $1\frac{1}{4}$ inches in diameter by 2 inches long, with $\frac{1}{8}$ inch central perforation piercing the $1\frac{1}{4}$ -inch faces.

(e) Primers (secondary) for Mark II and Mark II Mod. 1 naval defense mines in cylindrical blocks $1\frac{1}{4}$ inches in diameter by 2 inches long, with $\frac{1}{8}$ inch perforation piercing the $1\frac{1}{4}$ -inch faces.

553. Drying gun cotton.—

(1) *Methods of.*—

(a) Wet gun cotton may be dried by either of the following methods:

I. Exposure in a steam drier.

II. Exposure in a dry atmosphere.

(b) The quantity of dry gun cotton primers furnished being very small, the stock is to be replenished as fast as expended by drying wet blocks.

I.

(2) *Exposure in a steam drier.*—

(a) The steam drier must be placed above the water line, remote from fires or lamps and in such a position that it will not be subject to disarrangement. Its supply of steam is to be derived from a suitable part of the steam heating apparatus of the ship, or from any convenient source of low pressure steam heating at a navy yard.

(b) The blocks are to be dried, weighed separately and the weight of each is to be marked on the block with a soft lead pencil (never putting labels of any kind on the gun cotton). The blocks are then to be strung on the rods with the iron washers between them and placed in baskets of the drier. The baskets are placed in the drier, the door closed, the thermometer put in place, steam turned on and the ventilating openings are adjusted.

(c) The baskets, rods and washers must be kept free from dirt and oil.

(d) The temperature of the drying chamber must not exceed 100° F.

(e) After each day's heating, the blocks are to be removed carefully and weighed; the weights are to be marked on the blocks, and the drying is then continued. This process is to be

repeated until the blocks no longer lose weight, when all but a small percentage of moisture will have been expelled.

(f) When the drying is completed, the blocks are to be removed from the drier and placed, while still warm, in the metallic glass jars, or glass tubes, with strips of litmus paper between them. The containers are to be closed tightly, and the gun cotton is then to be stowed and inspected as dry gun cotton.

II.

(3) *Exposure in a dry atmosphere.*—

(a) String the blocks to be dried on a wood, brass or copper rod or pipe, which must be free from dirt or oil, or place them on a shelf made of wire netting, separating the blocks from each other to expose all surfaces freely to the air; suspend the rod or shelf in some suitable place, not in the vicinity of the galley or other fires, where the blocks will be freely exposed to the air and be under cover.

(b) Expose the blocks only when the atmosphere is dry. At all other times keep them in an empty powder tank in the immediate vicinity of the place selected for drying, kept closed to exclude moisture. Weigh the blocks every two days, noting on the blocks the date and weight with soft lead pencil. Continue the drying until the blocks show no loss of weight for two consecutive weighings, the weather being moderately dry. Then place the blocks in the containers, with strips of litmus paper between them, and treat them according to the rules given for dry cotton primers.

(c) Avoid unnecessary handling of the blocks, as they are apt to flake and crumble.

554. *Care and handling.*—

(1) *Temperature.*—The gun cotton magazine should never be allowed to attain a temperature as high as 100° F. for any length of time.

(2) *Direct rays of sun.*—Avoid as much as possible exposing any box or case containing gun cotton, either wet or dry, to the direct rays of the sun for any length of time, as the temperature inside the box can in this way be raised to a point considerably above that of the open air, and this temperature will be maintained for a considerable time after the exposure.

(3) *Changes of temperature.*—Diurnal changes of temperature will not affect gun cotton, wet or dry, provided the cases or boxes containing it are not exposed to the sun.

(4) *How packed.*—The dry gun cotton primers supplied to ships are packed in metallic glass jars or glass tubes with tight covers to exclude moisture. Strips of blue litmus paper are placed between the blocks of dry gun cotton.

(5) *Cases.*—The metallic glass jars or glass tubes are to be kept in their proper metallic cases as a part of the permanent outfit, and must be cared for and turned in as such.

(6) *Stowage*.—In stowing the dry primers, care should be taken that the cases are not too near each other. The explosion of a single primer will not detonate other dry primers unless they are within ten feet of the exploding primer. Dry primers must not be stowed in the vicinity of the galley or other fires, nor too near the guns of the battery.

(7) *Exposure to sun*.—In removing from their cases the metallic glass jars or glass tubes holding the dry gun cotton, never expose them to the rays of the sun, as the glass may act as a lens and affect the stability of the gun cotton.

(8) *Separation*.—The separation of boxes of dry gun cotton primers by a distance of ten feet will prevent the danger of a fire on board ship being communicated directly from one box to another. Under ordinary conditions, small quantities of dry gun cotton will not be detonated by influence at distances greater than three or four feet.

(9) *Above water*.—Dry gun cotton should be stowed above the water line. This precaution is taken so that the explosive will not become damp by absorption of moisture, and thus be too wet to detonate when required for use, and also as a measure of safety to the ship.

(10) *Stability*.—Dry gun cotton, when kept out of sunlight and not exposed to a temperature above 105° F., does not deteriorate if properly made. All gun cotton issued to vessels is tested immediately before it is shipped from the Torpedo Station, and none whose test is low is allowed to be issued.

(11) *Effect of heat*.—Dry gun cotton, when brought into contact with a flame or with any material heated above the ignition temperature of the cotton, burns rapidly with a yellow flame and is quickly consumed. Small quantities, such as are contained in dry gun cotton primer jars, will not detonate under these conditions. In order to produce a detonation the gun cotton would have to be confined and the entire mass brought to the ignition temperature at once.

555. *Inspections*.—The following inspections of gun cotton must be regularly made and the results entered in the ship's log:

- I. *Weekly*, all dry gun cotton.
- II. *Monthly*, all dry gun cotton.
- III. *Quarterly*, all wet gun cotton.

I.

(I) *Weekly inspections*.—

(a) All dry gun cotton primers must be inspected weekly. This is to be done, without opening the metallic glass jars or glass tubes, by observing the condition of the blocks and the strips of blue litmus paper placed between them.

(b) In the event of any serious decomposition having taken place, the gun cotton will be found more or less covered with

pasty, yellow spots; the jars will be filled with brownish-red highly acid fumes, and the litmus paper will show a decidedly red color.

(c) If the gun cotton is actually decomposing, it should be thrown overboard, after a sample block is set aside for reference. This sample should be placed in a clean glass bottle, be wet thoroughly with pure water and the bottle closed tightly. At the first opportunity it should be forwarded, with a full statement of the facts, lot number, etc., direct to the Naval Proving Ground, Indian Head, Md., or to the Naval Torpedo Station, Newport, R. I., as the Bureau of Ordnance may direct, in order that its condition may be examined carefully and the diagnosis made on board ship verified. A copy of the statement of facts will be forwarded at the same time to the Bureau of Ordnance.

(d) No gun cotton is to be thrown overboard unless a board has pronounced it to be in the condition above described. This caution is very important, as considerable valuable gun cotton has been condemned and destroyed, and a sense of insecurity has arisen in consequence of errors of inspection.

(e) It frequently occurs that the blue litmus paper becomes faded by exposure of jars, but no danger is to be apprehended in consequence.

(f) If the litmus paper has become reddened, but no fumes or pasty spots are observed, the block should be removed and placed on a perfectly clean, dry piece of blotting paper. Then separate the blocks, being careful not to touch them with the fingers. (A perfectly clean, dry crash towel may be used in handling the blocks.) Remove the strips of litmus paper, insert freshly moistened strips in their places. After an hour's interval examine the ends of the strips of litmus paper.

(g) If the strips of litmus paper have become reddened, replace the blocks of gun cotton in their containers, wet them thoroughly with pure water and at the first opportunity forward the containers and contents to the Naval Proving Ground, Indian Head, Md., or the Naval Torpedo Station, Newport, R. I., as the Bureau of Ordnance may direct. In this latter case none of the gun cotton is to be thrown overboard, as there is a much greater chance for error in inspection.

(h) If the moistened strips of litmus paper do not become reddened after one hour's exposure, replace the blocks in the container, close it tightly and return it to its box.

II.

(2) *Monthly inspection.*—

(a) Even if no change is observed in the litmus paper at the weekly inspection, the test just described, with freshly moistened strips of litmus paper, is to be applied to all gun cotton once

each month; this constitutes the monthly and quarterly inspections.

(b) In case the gun cotton is decomposing, the procedure described under weekly inspection is to be adopted.

III.

(3) *Quarterly inspection.*—

(a) The wet gun cotton is packed in the torpedo war heads, or in the mine charge cases or countermines, and the weight of the wet cotton and its containing case is stamped on the case. The cotton contains as nearly as is possible 25% of water. These cases are again packed in stowage boxes, and the gross weight of the wet gun cotton, war head (or mine charge case) and stowage box are stamped on the outside of the box.

(b) The cases are to be weighed separately every three months, and any loss in the gross weight is to be made up by the addition of pure distilled water, poured through the filling hole, which is then to be closed carefully.

(4) *Precautions to be taken.*—

(a) Do not handle the gun cotton with the bare hand.

(b) Never touch litmus paper with the bare hand. Blue litmus paper may become reddened by acid substance exuded from the skin. Litmus paper should always be handled with forceps provided in the chemical box.

(c) Always moisten litmus paper before making the test, using the distilled water provided in the chemical box.

(d) Hold the litmus paper in the forceps, dip one of the glass rods provided in the chemical box in the bottle of distilled water and then apply the moist rod to the paper. The litmus paper should be moist only and not flooded with water. Should the supply of water in the chemical box be exhausted, water distilled on board or fresh rain water may be used, provided it has been tested and found free from acid reaction.

(e) Make a comparative test to prove the absence of an acid reaction. As blue litmus paper may sometimes appear slightly red when moistened with distilled water only, a comparison should always be made by taking two pieces of fresh paper, moistening one with distilled water and the other with dilute vinegar.

(f) Always examine the test papers by a white light. Litmus paper will present a reddish appearance in any compartment that it shellacked or colored. The examination of test papers should therefore be made only in a well lighted room or in the open air.

(g) Do not mistake iron rust for pasty yellow spots. Gun cotton sometimes becomes rusted in the course of manufacture or from the case in which it is packed. The rust does no harm.

(h) Avoid unnecessary handling of the blocks, as they may flake and crumble.

556. War heads.—

(1) *Description*.—A war head complete consists of the charge, the primer and the detonator.

(a) The charge is the wet gun cotton contained in the head. The weight of the charge is the actual weight when wet.

(b) The primer is the dry gun cotton which is used to detonate the charge. The weight of the primer is its actual weight dry, which is approximately 1 pound 6 ounces.

(c) The detonator is the fulminate of mercury mixture used to detonate the primer. The percussion detonator is always used in torpedoes.

(2) *Weight*.—The gross weight of the shell and of the enclosed charge, when it has the required percentage of moisture, is stamped on the bulkhead of the war head.

(3) *Information*.—To each war head is attached a tag giving all necessary information regarding weights, lot and date of loading.

(4) *Stowage*.—The war heads are stowed in the torpedo war head room, which is arranged for flooding in the same manner as other ammunition rooms.

(5) *Method of loading*.—When loading torpedo war heads and Mark II and Mark II Mod. I mine charges, the blocks are cut by means of a band saw to conform to the shape of the shell of war head or container.

557. Mine and wrecking charges and countermines.—

(1) *Mine charges*.—Mark I mine charges, four of which are supplied for each Mark I naval defense mine, contain 50 blocks of gun cotton to charge, or approximately 36 pounds dry weight; with four blocks in the primer case as a primer, or approximately 2.72 pounds dry weight.

(2) *Wrecking charges*.—These are the same as Mark I mine charges, but are used singly or in numbers as the service on hand requires.

(3) *Mark II and Mark II Mod. I*.—These are cylindrical in shape and are loaded similarly to war heads by sawing either the large or small blocks to proper shape; weight of charge of gun cotton approximately 147 pounds dry weight, with five blocks of 2.9 x 2.9 x 2 inches gun cotton primers, weighing approximately 3.4 pounds dry weight in primer case; and a secondary primer of one block of gun cotton in the firing mechanism around the percussion detonator, weighing approximately 1.35 ounces dry weight.

(4) *Countermines*.—Countermines, or improvised mines, may be loaded with any of the above size of blocks or scrap gun cotton.

558. Primers.—

(1) *Definition.*—The detonating charges of dry gun cotton which are used to explode the charge of wet gun cotton are designated *primers*.

(2) *War head primers.*—Dry primers for torpedoes are packed in glass tubes enclosed in metal deck beam cases or wooden bulkhead boxes, strips of litmus paper being placed between each block. The glass tubes are closed at each end by wooden covers or rubber washers. They must be stowed above the water line in a cool, dry, secure place, as far as possible from the guns. When more than one box or case is supplied they shall be stowed apart.

(3) *Mine charge primers.*—These are packed in metallic glass jars, each jar having the capacity of eight blocks of 2.9 x 2.9 x 2 inches with central perforation, strips of blue litmus paper being placed between the blocks. Two jars are in a wooden case which is enclosed in a brass case and is stenciled with contents and precautions as to stowage. They are never to be stowed below, but are to be stowed in different parts of the ship above the water line.

(4) *Glass containers.*—Being in glass, containers allow inspection without opening the case.

(5) *Stowage.*—When received on board ship these cases are stowed in different parts of the ship, never below the water line. They should be kept as near the upper deck as possible, so that they may readily be thrown overboard in case of fire, but should not be exposed to the direct rays of the sun nor to the elements or the weather.

(6) *Shipping.*—When possible to ship by public conveyance or issued direct, the dry gun cotton should be in its proper container; but when necessary to ship by rail the primers will be shipped wet, with 25% moisture, in their proper containers, to be dried and then stowed as laid down for dry gun cotton primers.

(7) *Wet primers.*—When issued, these are packed in brass cylindrical containers, stamped on the cover of the container is the gross weight of the container and primer, with 25% moisture, and are stowed where most convenient, but never near dry primers or detonators.

559. Detonators.—The fulminate of mercury charges used to detonate the primers are known as *detonators*.

(1) *Description.*—Detonators are of two kinds, electric and percussion.

(a) Electric detonators are used in mines which are to be fired by electric current.

(b) Percussion detonators are used in torpedo war heads and mechanical contact mines.

(2) *Electric detonators.*—

(a) Electric detonators are cylindrical copper cases, containing 35 grains of fulminate of mercury, primed on top with dry, pulverized gun cotton.

(b) A plug is made of one part of ground glass and two parts of sulphur melted together, cast around the detonator legs. These legs are tinned copper wires, No. 20 A. W. G., six inches in length, insulated with a double layer of cotton thread soaked in paraffine, the outer layer colored red.

(c) The inner legs of the detonator are bridged by a platinum-iridium wire, 90% platinum, 10% iridium, $\frac{1}{8}$ inch long and 2 mils. in diameter, having a resistance of 60 ohms, plus 10 or minus 5 ohms.

(d) Electric detonators are painted red.

(e) Electric detonators are issued in boxes containing eight. If one detonator should be exploded accidentally, all other detonators will explode. There is reasonable assurance that if one box of detonators exploded, another at a distance of one foot will not explode if it is protected from the flying fragments of the exploded detonator cases.

(f) Blocks for electric detonators are wooden cylinders. The detonators are placed in holes around the circumference, the cover locking them in. The blocks are placed in a covered tin cylinder, painted red and marked *dangerous*.

(g) They are stowed in different parts of the ship, preferably in the tops, but not below the water line or near any other explosive.

(3) *Percussion detonators.*—

(a) These are cylindrical copper cases containing 35 grains of fulminate of mercury, and are primed on top with dry, pulverized gun cotton. They are closed at the bottom and have in the top a fulminate cap connecting by means of a small channel with the interior. An anvil which rests on this cap detonates it when struck, and this in turn detonates the fulminate charge.

(b) Percussion detonators are painted red.

(c) Boxes of percussion detonators are made of cork forms which fit tightly in tin boxes and have holes for the detonators. The lid of the box is lined with cork and closes tightly on the heads of the detonators, thus preventing any motion.

(d) They are stowed in different parts of the ship, preferably in the tops, but never below the water line or near any other explosive.

560. *Trinitrotoluol.*—(T. N. T.)

(1) *Properties.*—The excellent properties of this substance may be summarized as follows:

(a) Chemical stability,

(b) Lack of chemical attraction,

(c) Safety and innocuousness during manipulation.

(d) Non-hygroscopicity and absence of fire risks.

(e) Insusceptibility to shock and blow.

(2) *General use.*—Dry gun cotton primers are being replaced by compressed trinitrotoluol. It is furnished in paper tubes for torpedo war heads and some types of mines, with full directions on the paper tube as to the proper method of using it. For Mark I and wrecking mine charges the trinitrotoluol is compressed in primer case in charge when issued. It is proposed to have all future torpedo war heads and mine charges of cast trinitrotoluol.

(3) *General description.*—Trinitrotoluol is obtained by step-up nitration of toluol and dinitrotoluol according to known methods. In order to obtain the highest purity, the trinitrotoluol is finally dissolved and recrystallized, yielding an end product free from impurities and low grade nitro bodies.

(4) *Appearance.*—It is a fine, yellowish crystalline powder when in granulated or compressed state, which changes to a deep brown when cast. Trinitrotoluol is non-acid in reaction, non-poisonous during manipulation and does not stain.

(5) *Non-vaporous.*—During casting, no vapors are given off and no froth is formed. This renders the operation of filling war heads and mine charges less troublesome than does gun cotton.

(6) *Stability.*—Trinitrotoluol is a perfectly stable body, and neither exposure to the atmosphere nor contact with metals will affect it.

(7) *Melting point.*—The melting point of chemically pure trinitrotoluol lies between 80° C. and 80.6° C., according to the methods employed.

(8) *Absorption of water.*—It is non-hygroscopic and practically insoluble in cool water. Either in compressed or cast state it is equally impermeable to water; consequently it does not lose its aptitude of explosion through absorption.

(9) *Preservation.*—No special means of preservation are therefore necessary either during storage or when filled in war heads or mine charge cases, but unprotected charges would, if immersed in water for any length of time, be subject to the corrosion and weed growth of the sea, like any other submerged body.

(10) *Inflammability.*—Under normal conditions trinitrotoluol is but slightly inflammable, but when ignited with a naked flame it burns only with difficulty, giving off a smoky flame. Its aptitude of detonation is highest for the granulated, somewhat lower for compressed and the lowest for the cast material. For this reason a granulated or compressed charge is used for completely detonating charges of the cast material.

(11) *Detonation.*—Electric or percussion detonators are used to detonate trinitrotoluol.

(12) *Precautions.*—No special precautions are necessary in the care of this explosive. Its chemical stability is unlimited. Atmospheric conditions have no influence on the charges, and they can be kept in any kind of magazine or storeroom.

(13) *High temperature.*—The only disadvantage of high temperature is in the expanding of the container of the charge, causing it to lose its adherence. This results in a loss of military value of the container. A temperature of 113° F. as a maximum should be the standard practice.

(14) *Exposure to water.*—In case of the flooding of store-rooms or magazines, the trinitrotoluol charges suffer no loss of their explosive power, even if months under water.

DEMOLITIONS.

561. Demolition work.—

(1) *General.*—Such demolition work as may be attempted by the Navy is not likely to be so extensive as that required of the Army, and the equipment of the "gun cotton detail" is largely extemporized from the charges of the naval defense mines that ships carry. While it would not be advisable to carry such material on shipboard continuously, it is probable that in emergencies, where much demolition work had to be done, dynamite or ordinary blasting powder would be acquired for that purpose. These materials are so widely used that they are cheap and readily obtainable in large quantities.

(2) *Wrecking mines.*—

(a) Briefly, the wrecking mine charges are sheet copper boxes about a foot square and nine inches high, filled with wet gun cotton, with a central case for a priming charge of dry gun cotton to be put in before using. The detonators are electric, and the splice is made inside the case. The insulated firing wire is packed with a spherical rubber washer where it leads through the screw cover. The charge is equivalent to 38 pounds of dry gun cotton. (T. N. T. priming charges are being adopted because safer and more convenient than dry gun cotton in requiring fewer inspections.) A battery and firing key with the outfit allow the simultaneous firing of several charges.

(b) It would be out of place to describe the outfit further, as an ordnance pamphlet explains each part with illustrations, even to the exact kind of splice to be used. This descriptive pamphlet should be thoroughly understood before attempting to use the outfit, and should be followed.

(c) The wrecking mine outfit is designed especially for use in destroying derelicts and blowing up hulks such as may have been used to obstruct channels. Specific rules for this kind of work are difficult to give, except to say that one charge at the base

of a mast should bring it down; that a number of charges fired simultaneously at different parts of the wreck is usually better practice than grouping all together, and that it is best first to blow the deck off lumber-laden wrecks to let the cargo go. Charges should be as deeply submerged as practicable, and with a charge ten feet deep, the boat should be at least fifty feet away before firing. If only the mast is above water, the charges can be strung around it and lowered away to the deck.

(3) *Nature of work.*—Having mentioned the naval wrecking mine outfit, it is well to remark that demolition is a broad term, covering every form of destruction of the enemy's property which has come into our possession. Blowing things up is by no means invariably the best way. If time permits, and there is little danger of fire spreading further than intended, it is easier and simpler to burn docks and buildings. Explosives are specially suited for destroying iron and brick structures, or masonry bridges, etc. Again, a timber bridge will fall if cut, and explosives furnish a means for doing this without being on it at the time; but if not pressed for time, burning is as good, or better.

(4) *Railroads.*—A very important part of demolition work is the crippling of railroad transportation. Rails are torn up and heated over fires until they sag of their own weight. They can be bent around trees, or can be twisted by bars through the bolt holes. Fish plates are cracked with hammers, and bolts and nuts removed. "Derailers," such as those used about railways, are ideal for wrecking trains at short notice, as they weigh only a few pounds, and have merely to be laid on one rail. Sections disconnected can be turned over bodily (two men to a tie). A heavy obstruction should be three feet deep and ten feet long, to stop a train. Rails may be disconnected and moved about a foot out of line. Merely to remove the fish plates and some of the spikes around a curve will usually cause a wreck. To blow up rails, use a stick of dynamite each side of the web; or a disk of gun cotton, or a half a pound of T. N. T. Rolling stock is burned, locomotives derailed, or run into head-on collisions, preferably in a tunnel, or if in haste, the boiler is destroyed by explosives inside of it, or by shooting a field piece through it, or by building a fire under it when empty. Links and small engine parts are removed.

(5) *Telegraph lines.*—To destroy a telegraph line, poles are cut down and burned, wires tangled, and insulators broken. To disable it temporarily, breaks, crosses or grounds may be made. There should be no difficulty in devising ways to cripple railroads and telegraphs; the above are given merely as a guide.

(6) *Safety precautions.*—

(a) Priming charges and detonators should not be put in before necessary to do so; the firing connections should be made only after all is clear, and explosives should not be exposed

to sparks or fire, or handled roughly. Everyone should know this, and all safety precautions are merely these statements in various forms. A wholesome respect for explosives (which is not outgrown with experience) is what is needed. Accidents are commonest among the experienced who take chances while knowing better. The unexperienced, if cautious, are relatively safe. Have the men handle explosives "like eggs."

(b) There are, however, a few things that may be added to the above, that one's caution would not of itself suggest. The principal of these is the behavior of dynamite in cold weather. Dynamite comes in sticks, usually paper covered. It is a mixture of nitroglycerine and "dope," sometimes inert, but more usually explosive. Sticks should be stowed horizontally to prevent exudation. In cold weather it freezes and gets hard. It has to be thawed to restore sensitiveness. This should be done either in a special hot water heater, or in a box packed with manure, and should not be hurried, for if overheated or roughly handled during this thawing process it is very sensitive. It may be frozen inside while soft on the outside. There are some "non-freezing" dynamites. In working with it and handling it, one gets a "nitroglycerine headache." Strong coffee or aspirin cures it. A detonator is stuck in one end of a stick, and the ends of the wrapper tied around with twine. The leading wires are given a hitch around the stick to keep a strain from pulling out the detonator. The detonator should be located as near the center of the mass of the charge as convenient.

(7) *Tamping*.—Tamping is not as necessary as with black powder, but it helps. It is the inertia of the tamping material that counts, and a plank with dirt on it laid over the explosive is quite effective. Earth tamping of a charge along the foot of a wall should be about $1\frac{1}{2}$ times as thick as the wall for maximum effect.

562. Hasty demolitions.—The following table is given by Weaver* for charges for hasty demolitions.

SUMMARY OF CHARGES FOR HASTY DEMOLITIONS.

(Using Dynamite or Gun Cotton Charges.)

B=length of breach to be made in feet.

T=thickness of object to which charge is applied in feet.

t=thickness in inches of iron plate.

These charges are for untamped conditions; if tamped, they may be reduced one-half.

When prepared in great haste in the presence of the enemy, increase the charges one-half.

* See "Military Explosives," by E. M. Weaver: published by John Wiley & Sons.

Object.	Lbs.	Remarks.
Hardwood trees, round.....	5T ³	Also piles, masts, etc.; encircling charge.
Hardwood beam, rectangular.	3BT ³	B=longer side of cross-section; encircling charge.
Hardwood stockade or barrier.	3BT ³	B=length of breach; T=maximum thickness of stockade; single charge.
Earth and wood stockade or barrier.	4 per foot....	This is for breastworks 2 to 3 feet thick, made of earth rammed between planks or railway sleepers.
Iron rail stockade or barrier.	7 per foot....	This is made of iron rails touching each other, placed in ground on end.
Hardwood tree, round.....	3/8T ³	T=smallest diameter of tree; auger-hole charge. Hole bored radially, so that center of charge shall be at center of tree.
Brick and masonry revetments.	1/4BT ³	Charge placed behind revetment against its back surface; for scarp walls of forts and surfaces of tunnels.
Heavy gates.....	50 lbs.	Gates of forts, armories, etc.
Iron plates, wrought or steel.	3/2Bt ³	t=thickness in inches. Laminated plates same as solid.
Detached masonry or brick wall, less than 2 ft. thick.	2 per foot....	Charge calculated by last formula would be too heavy, and simply blow a hole through wall.
Detached masonry or brick wall, over 2 ft. thick.	1/2BT ³	If over 2 feet thick.
Masonry piers of bridges....	2/3BT ³	Placed against the pier in close contact.
Masonry arches of bridges..	3/4BT ³	Placed along the crown of haunches.
Field- or siege-guns, or R. F. guns.	1 1/2 lbs.	Placed on the chase near the muzzle.
Large seacoast guns.....	4 lbs.	In bore tamped from the breech and muzzle with sand or earth.
Steel rails.....	2/3 lb.	Lashed tightly to web of rail.
Inflammable buildings or materials may be ignited by	1 disk of dry gun cotton.	Disk should be simply ignited, not detonated.

Explosive gelatine would require charges 20% less than those above. Gunpowder would require charges 4 times greater than those above.

563. Army methods.—In the field manual of the Army Engineers the following appears:

(1) *Weight of explosives.*—All calculations of weights of charges are based on the use of an explosive equal in strength to a 50% dynamite. A stick will be understood to mean a cylindrical cartridge 1 1/4 x 8 inches, which will weigh approximately 0.6 lb. A chain will be understood to mean a number of such sticks end to

end, in close contact, and is taken at 1 pound per running foot. The cartridges of a *string* will usually be attached to a rope or pole. When two or more strings of cartridges are to be used, they may be lashed to the same support. In all the following formulas C represents the charge of 50% dynamite, or its equal in strength in pounds; d, the diameter in feet; B, the breadth of the section to be ruptured; and T and t the thickness in feet and inches, respectively.

(2) *Timber*.—A charge of $\frac{1}{2}$ pound per square foot of sectional area, placed in holes in the same cross section, will cut off trees and round or squared timbers of usual proportions. The holes should be tamped with clay behind the cartridges. One, two, three and four sticks will cut off trees or poles 13, 19, 23, and 27 ins. diameter respectively. The center of the charge should be at the center of the section. If the holes meet, one primer at the middle will do. If they do not meet, as will usually happen in large trees, a fuse for each hole is required and simultaneous ignition. If firing must be done with time fuse, it may be well to charge and fire one hole, then bore another in the soundest part remaining, charge and fire it, and so on, until the tree falls.

A round timber not over 12 inches diameter may be cut by a chain completely encircling it in the same plane. It must set snug against the wood and should be fired with primers on both sides.

Such a charge fired 3 ft. under water will cut any pile or trestle leg likely to be encountered. Close contact is not so necessary under water, and it is convenient to lash the charge to a wire ring or to a band or hoop and slip it down.

For squared timbers the charge is placed in one or more holes parallel to one plane. The direction will depend on the dimensions of the timber as compared with the length of a stick. The holes should not go entirely through, and should be somewhat deeper than the stick is long to allow of tamping. Broadly speaking, the hole should be bored in the direction of the dimension which is nearest 12 ins. for whole sticks or in the direction which is nearest 8 ins. and charged with half sticks.

It may be necessary to cut bridge timbers when there is not time to bore. The charge required is 4 lbs. per sq. ft. of section, and may be placed as a chain around, if square or nearly so, or if the piece is thin as compared with its width, across one long side.

(3) *Stockades and stockaded walls or palisades*.—These are destroyed by strings or cartridges covering so much of their length as it may be necessary to break down. The cartridges cannot be got close to the wood except in the case of square timbers, and more powder is required than the actual cross section of wood calls for. Besides, it may not be known what the construc-

tion of the stockade is, or what strength it may have from braces or other reenforcement.

The charge is best placed along the foot of the wall and should be tamped, especially in the intervals between timbers. So far as its flexibility suffices, the string should be bent to fit the contour of the logs as snugly as possible.

If the demolition is deliberate and the structure can be examined, one or two strings well placed and tamped will throw down a single wall or one side of a double wall. If the work is to be done under fire, determine the minimum length of breach actually required and place and fire a charge of four strings tamped as well as conditions permit.

(4) *Masonry*.—For ordinary walls, the charge per running foot varies with the square of the thickness, or $C = 0.85T^2$. The charge should be laid in chains along the foot of the walls. If a tamping equal in thickness to the wall is placed the charge may be reduced one-third. If besides the tamping a groove is cut to hold the charge, the weight of the powder may be reduced one-half.

The following table shows the number of chains required to throw down walls of usual thickness:

Thickness of wall. Ins.	Number of chains required.		
	Not tamped.	Tamped.	Grooved and tamped.
13	1	1	1
18	2	2	1
22	3	2	2
26	4	3	2

The walls of a house may be blown down with charges taken from the above table. It is sufficient to charge the walls between windows only, preferably inside and with tamping. In haste, one or more charges of 50 lbs., in a central position will demolish the house.

Locks should be attacked at the miter sills, the lower first. Start the gates open slightly and place a concentrated charge between them and the upper edge of the sill.

(5) *Masonry bridges*.—A single arch is best attacked by charging across the arcs at the haunches, or across the crown. The charge should be one-half more than for a wall of the same thickness. Both methods require digging, and if the filling is of masonry the former is scarcely practicable. Both methods also interrupt traffic on the bridge which it may be important to use until the last moment. A thin arch may be broken by a heavy charge exploded on the roadway at the crown. It should be tamped by throwing a mound of earth over it. The charge

should be not less than T^2 lbs. per running ft. T reckoned from surface of roadway to underside of arch.

The charge may be placed in a trough and suspended under the crown. The sides of the trough should make 60° angle. Planks 12 inches wide will make a trough to hold 36 chains of $1\frac{1}{4}$ cartridges or 36 lbs. to the running ft. If the number to be used will not completely fill the trough, earth must be placed in the bottom so that the top tier of the cartridges will project slightly above the edges of the boards. The trough must not be allowed to sag away from the arch at the middle. If necessary, truss it up.

Primers should be placed three or four ft. apart in the middle chain of the top tier and the wires or fuse led out through notches in the sides.

It is for this kind of work that the wrecking mine outfit would probably prove most useful on shore, a string of wet gun cotton charges being used.

A bridge of more than one arch is usually most easily attacked at the piers. The destruction of one pier throws down two arches. The charge should be placed where the pier is the thinnest and should extend across one face. If possible, a groove should be cut in the pier, or irregular voids made by prizing out stones from the same course. This lessens T , partially tamps the charge, and furnishes a convenient support, which must otherwise be provided in the shape of a shelf, trough or other device.

(6) *Metals*.—As soft steel so greatly predominates in structural work, statements under this head will relate to that metal.

All charges will be external, as drilling or boring is not practicable. The standard formula is $C = 2.5 Bt^2$, in which C = the charge in lbs., B the width of the section in ft., and t its thickness in ins. The charge must extend entirely across the plate or sheet.

The following table gives the charges necessary to cut through a plate one foot wide and of the thickness given. It is computed from the above formula for 50% dynamite.

Thickness of plate.	Charge of 50% dynamite.	Thickness of plate.	Charge of 50% dynamite.
<i>Ins.</i>	<i>Lbs.</i>	<i>Ins.</i>	<i>Lbs.</i>
$\frac{1}{4}$	0.16	$1\frac{1}{4}$	3.90
$\frac{1}{2}$	0.62	$1\frac{1}{2}$	5.62
$\frac{3}{4}$	1.40	2	10.00
1	2.5	3	23.50

A single chain will cut a plate up to $\frac{5}{8}$ in. thick. Two, three and four chains will cut plates of $\frac{7}{8}$, $1\frac{1}{8}$, and $1\frac{1}{4}$ ins. thickness, respectively. The charge must be held snugly against the plate by a piece of plank, lashed or wedged, and whenever possible,

must be tamped. For structural shapes figure the width as the sum of web and flange widths, and the thickness as the area of cross section in sq. ins.

The charge should be in three parts—one on the web, and one on each flange. For channels, angles, and Z bars the entire charge may be on contiguous surfaces, and one primer will suffice. For I beams the flange charges should be on the outside and three primers are necessary.

As one chain will cut up to $\frac{5}{8}$ in. thickness, and two chains up to $\frac{7}{8}$ in., the choice will usually lie between the two, as few pieces of structural steel will be found with greater thickness than $\frac{7}{8}$ inch.

For lattice girders, diagonals, and posts all the longitudinal members should be cut. For plate girders the web and both flanges should be cut. If short of powder, cut the lower flange and lower part of the web. For a box girder, figure all four sides as plates. If powder is scarce omit the top. For a beam girder, figure the flange charge for the combined thickness of beam flange and plate.

(7) *Cutting bridges.*—Wooden trusses are best cut near the middle of the power chord. Steel trusses and girders, if a complete fall is desired, should have every member cut on the same cross section. Continuous girders or trusses must be cut near the end of the shore spans opposite the abutment.

Metal girders and trusses are better cut near the abutments, where the cross sections of chords and flanges are smaller. Where members meet or cross, as at panel points, etc., it is usually possible to place charges in a more or less acute angle and then tamp by throwing earth upon them. The effect of the charge in such a situation is always greater than if placed against the side of a single member, and, unless the panel points are of very massive construction and so complicated as to make the effect of the charge uncertain, it will be better to choose them as the location for cutting, remembering that a complete rupture of the entire cross section of the bridge is the object in view. Panel points and intersections will be selected so as to attain this object with the smallest number of charges.

A cantilever bridge should be cut over the towers, with especial attention to the complete rupture of the top chords.

Wire cables of suspension bridges are difficult to cut. The best place to work is between the cable and the top of the tower, near the saddle. There is no reliable data as to charges required. A French formula gives $C = 0.42 t^3$, in which t is the diameter of the cable in inches.

(8) *To interrupt traffic.*—Rails may be cut and frogs and other parts of switches broken. A stick fastened against the web of a rail up to 70 lbs. will cut a gap in it about a foot long; if the charge be tamped, a heavier rail may be cut. Such a cut may be

made to produce derailments, but for other purposes two charges should be fired on opposite sides and a few feet apart, which will blow out a piece and distort the ends.

A stick in the groove of a frog and covered with ballast will wreck the frog. A stick between the two rails, as, for example, a track and a guard rail, or the main line and switch rail, will cut both. In such a situation tamping is easy and should always be done.

564. Demolition by Trinitrotoluol.—

T. N. T., being a new service explosive, may perhaps be used for demolition work. Loose T. N. T. can be made up in sausages in duck bags and is very convenient in that form. Wire nails can be safely driven through it to attach such tubes around timbers in an encircling chain, and the detonators stuck in through slits made with a knife. These tubes are convenient to carry, they can be cut to desired length with a knife, and the ends tied with twine after dumping a little out. In blowing up flat shapes a primer on each side should be used to insure good detonation, particularly if the tube is thin. Recent tests at Indian Head have shown this works very well even for hard oak timbers up to 12 x 16 inches, if a charge of one pound for each 20 square inches of sectional area is used for rectangular section, and for round timbers one pound for each 50 square inches of the area of the circumscribed square. The charge should be three-quarters of a pound or over in all cases.

PART VI

SHIP MANUALS

	PAGE
QUARTERS FOR MUSTER AND INSPECTION.....	169
GENERAL MUSTER	172
THE GUARD OF THE DAY.....	173
GUARD MOUNTING	179

SHIP MANUALS.

QUARTERS FOR MUSTER AND INSPECTION.

601. The calls.—

(1) *Officers' call.*—Call No. 7. This is to be sounded five minutes before the routine time for quarters, taken up and repeated by all the buglers at the bugle stations. At this call officers and men will gather in the vicinity of the *division parades*.

(2) *Assembly.*—Call No. 8. This is to be sounded at the routine time for quarters, taken up and repeated by all the buglers at the bugle stations.

602. *Division parades.*—Each division should be assigned a parade—a space on deck for its habitual formation. The fair weather parades are on the uncovered decks. The foul weather parades are on the covered decks. The assignment of division parades should be such that men have only one parade and one formation for all events. Gunnery department divisions should be so assigned that one side of the ship balances the other side of the ship, in order that the divisions will appear properly disposed on going in and out of port. All other departments than the gunnery department should have deck space assigned them fulfilling two requirements: (1) That the divisions (or crews) of the department form contiguously, and (2) that those departments of the ship's company present a well-balanced formation going in or out of port.

603. Duties of officers.—

(1) *Heads of departments.*—Each head of department will command his own department at quarters for muster, and will report his department to the executive. Where the navigating officer takes the deck his department should be reported to him by his next in rank in his own department, and the report then made by the navigating officer to the executive.

(2) *Division officers.*—Division officers and crew leaders will report their divisions and crews to their own head of department.

604. *Department formation.*—As far as possible, departments will form with all divisions facing to *starboard*. On going in and out of port all divisions shall be formed facing *outboard*.

605. Posts of officers and petty officers.—

(a) The post of the gunnery officer should be on the starboard side of the ship, as near equi-distant as may be from all the divisions of his department. The posts of the other heads of departments are in front and center of their divisions.

(b) The post of the division officer is in front and center of his division.

(c) The post of the division junior officer is in rear of center of his division.

(d) The post of the division leading petty officer is on the right of the section leading petty officer of the first section.

(e) The posts of the section leading petty officers are on the right of the front rank of their sections.

(f) The posts of the other chief petty officers are in rear of their own sections, in line of file closers.

(g) The squad leaders occupy the right file of the front rank of their squads.

(h) Other petty officers take posts in the front rank of their own sections, from right to left in order of seniority.

(i) Seamen and firemen, first class, in the front rank.

606. To form the division.—All divisions will form in two ranks; the right wing composed of the first and third sections of the watch bill; the left wing composed of the second and fourth sections of the watch bill.

(1) At the sounding of *assembly* the division leading petty officer in front of and facing the center of the division commands **FALL IN**; at which the watch sections form with the section leading petty officers on the right of the front rank of their sections.

(2) The division leading petty officer commands **MUSTER THE SECTIONS**; at which each section petty officer takes one step to the front, faces to the left, and musters his section. Each faces to the front when his muster is completed.

(3) The division leading petty officer then commands 1. *Section leaders to the front and center*; at which the section leaders face toward center; 2. **MARCH**; at which section leaders march to center and face to front.

(4) The division leading petty officer then commands **REPORT**; the section leaders report in succession from the right.

NOTE.—Section leaders do not salute the division leading petty officer.

(5) The division leading petty officer then commands 1. *Posts*; at which the first and third section leaders face right, the second section leader faces about, and the fourth section leader faces to left; 2. **MARCH**; at which the section leaders take their posts; each on the right of front rank of his own section.

(6) The division leading petty officer then places himself, facing to left, one pace on the right of the front rank of the division and commands 1. *Right*; 2. **DRESS**; dresses the division, and commands 3. **FRONT**.

(7) The division leading petty officer then moves to the front and center, and facing the division officer salutes and reports
Sir,

(8) The division officer returns the salute and commands 1. *Post*; and the division leading petty officer takes his post on the right of the front rank of the division. [See paragraph (9aa).]

(9a) For inspection by the division officer: The division officer commands **FORM FOR INSPECTION**. The division junior officer, placing himself on the right of the front rank facing to left, commands 1. *Open ranks*; at which the division leading petty officer drops to the rear a sufficient distance (governed by the deck space) to form the alignment for the rear rank; 2. **MARCH**; at which the rear rank steps back to its alignment on the division leading petty officer; both ranks dress to the right. The division junior officer aligns both ranks, places himself on the right of the front rank facing to the left and commands 3. **FRONT**; at which the division leading petty officer resumes his post. The division junior officer then proceeds to front and center, faces the division and commands 1. *Hand*; 2. **SALUTE**; at which the division executes the right-hand salute. The division junior officer then faces about and, saluting the division officer, reports *Sir, the division is ready for inspection*. The division officer returns the salute and commands *Post, Sir*, and the division junior officer takes post to left and rear of division officer. The division officer then commands **Two**; at which the men drop right hands to side.

(9b) The division officer, accompanied by the division junior officer, proceeds to inspect his division, passing from the right to the left along the front rank, and from the left to the right along the rear rank.

(9c) The inspection completed, the division officer commands to the division junior officer *Take charge, Sir*, and proceeds to the front of his head of department; and, at parade rest, awaits the head of department's order to **REPORT**.

(9d) The division junior officer places himself in front of center and commands 1. *Close ranks*; 2. **MARCH**; 3. *Parade*; 4. **REST**; faces about and takes the position of parade rest. [See paragraph (10).]

(9aa) Should there be no inspection of the division to follow the procedure given in paragraph (8), the division officer commands *Take charge, Sir*, and proceeds to report to his head of department as in (9c). The division junior officer proceeds to bring the division to the parade rest as in (9d).

(10) Upon return of the division officer to his division he relieves the division junior officer, who takes his post in rear of center, and the division officer then proceeds to carry out the routine.

607. Succession in the division.—In the absence of the division officer his prescribed duties in the division formation are taken by the division junior officer; and the duties prescribed for

the division junior officer are taken by the division leading petty officer in addition to his own.

608. Formation of small divisions, or crews.—In the case of those departments whose divisions are small units, the procedure given in Article 606 should be abridged as required.

609. Formation after "secure."—After *secure* from every drill or exercise, the divisions will assemble in the above formation. The division leading petty officer on the right flank of the division, facing left, will command **FALL IN**; 1. *Right*; 2. **DRESS**; 3. **FRONT**; 1. *Parade*; 2. **REST**; and, resuming his post, comes to the parade rest. The division thus awaits the call *retreat*.

610. Inspections.—

(1) *By the head of the department.*—When the head of department inspects the divisions of his department each division officer places himself on the flank of the front rank from which the head of department approaches, and presents the division with the command 1. *Hand*; 2. **SALUTE**; 3. **Two**; and accompanies the head of department on his inspection of the division.

(2) *By the commanding officer.*—The same formalities are to be observed as in paragraph (1). The head of department will accompany the commanding officer when the commanding officer inspects the divisions of his department.

NOTE.—The front rank is not to be faced about as a matter of routine, unless required for some particular occasion.

GENERAL MUSTER.

611. Formation.—

(1) At the call (*No. 64*), heads of departments command, *Division officers take charge*. Heads of departments then form in rear of the captain in order of seniority from right to left, at parade rest. Each division officer marches his division to its designated place in the massed formation; and, taking post on the right or left flank of the division as will bring him nearest to the captain, commands 1. *Parade*; 2. **REST**; and takes the position of parade rest. The division junior officer, at parade rest, takes post in rear of division officer.

612. Ceremony.—

(1) When all the divisions are massed the executive commands to the bugler *Sound attention*; to the ship's company 1. *Hand*; 2. **SALUTE**; faces about, salutes, and reports to the captain *Sir, all hands are mustered*. The captain returns the salute and commands *Publish the orders, Sir*. The executive faces about and commands 3. **Two**; at which the men drop the hands.

(2) The executive commands 1. *Attention to orders*; or 1. *Articles for the Government of the United States Navy*, as the case may be; 2. *Parade*; 3. **REST**; and publishes the orders in hand.

(3) The orders published, the executive commands to the bugler *Sound attention*; faces about, salutes, and reports to the captain, *Sir, the orders are published*. The captain returns the salute and commands *Pipe down, Sir, or Carry on, Sir*, as the case may be.

(4) The executive faces about and commands to the bugler *Sound the assembly*; division officers then march the divisions to the division parades, and the heads of departments resume command of their departments.

THE GUARD OF THE DAY.

(When Seamen are on Guard Duty.)

613. The officer of the guard.—The officer of the guard occupies a position below decks analogous to that occupied by the officer of the deck above decks. He is subordinate to the officer of the deck, whose commands he must obey, but he receives his general orders from the executive, to whom he reports directly. He has, both above and below decks, immediate command over all that relates to the interior discipline of the ship, and he has general charge of the prisoners. Below decks he is responsible for the lower decks routine.

614. The chief petty officer of the guard.—The responsibilities of the chief master-at-arms are given in A. G. N., Article 8, and the Regulations. He is the chief petty officer of the guard. He is subordinate to the officer of the guard. The petty officers and men of the guard are subordinate to him.

615. Lower deck petty officers.—Gunnery department and engineering department divisions will detail petty officers in charge of the cleaning and discipline of their lower deck compartments and spaces. In matters of discipline, cleaning and care and preservation these lower deck petty officers receive their orders from their own division officers. In matters of police duty and lower decks routine they receive their orders from the officer of the guard through the chief master-at-arms.

616. Strength of the guard.—

(1) In battle ships, armored cruisers and cruisers of the first class the *guard of the day* shall consist of

(a) One officer of the guard.

(b) One chief petty officer of the guard (the chief master-at-arms).

(c) Four petty officers of the guard.

(d) Twenty-four men of the guard.

(2) Other types of ships will not be required to provide for a guard of the day in their organizations.

617. The rosters.—

(a) Junior officers serve on *roster (a)*, which is kept by the executive.

(b) Chief petty officers of the gunnery department divisions may serve on *roster (b)*, which is kept by the gunnery officer.

(c) Petty officers, first, second and third classes, of the gunnery department divisions serve on *roster (c)*, which rosters are kept by the division officers.

(d) Seamen and ordinary seamen serve on *roster (d)*, which rosters are kept under the direction of the division officers.

618. Details and tours.—All guard details come from the section on duty for the day. Every morning before quarters the chief master-at-arms shall report to the division officers the petty officers and men of the guard that are to be furnished for the next day; and the division officer, at quarters, will have the details notified, and will cause a list of his details to be furnished to the chief master-at-arms. The tour of guard duty is twenty-four hours. The tour of a petty officer of the guard, an orderly or sentinel on post is two hours.

619. Posts of sentinels.—The strength of the standard guard permits six posts. Where the posts are less than six the guard may be organized into more than four reliefs; in which case petty officers additional to four will be required in the guard detail. Where the posts number more than six, additional men of the guard will be required in the detail, so as not to reduce the guard below four reliefs. The captain regulates the number of posts.

620. Uniform and arms of the officer of the guard and of the guard.—

(1) *In port:*

Officer of the guard,

(a) Uniform of the day, with leggings.

(b) Sword and gloves.

Men,

(a) Uniform of the day, with leggings.

(b) Equipment, service rifle belt.

(c) Arms, service rifle; with or without ammunition, as ordered.

(2) *At sea:*

Officer of the guard and men of the guard,

(a) Uniform of the day, without leggings.

(b) Equipment, service pistol belt.

(c) Arms, service pistol as ordered; with or without ammunition, as ordered.

(3) The chief master-at-arms is exempted from wearing arms and equipment, and from guard mount and all formations.

(4) The division officers are responsible as to the uniform of their details which report for guard duty, and that their details are fit for duty.

621. The commander of the guard.—

(1) The officer of the guard is the commander of the guard, and is responsible for its instruction and discipline. He will see that all its members are correctly instructed in their orders and duties, and that they understand and properly perform them. He receives and obeys the orders of the commanding (executive) officer and the officer of the deck, and reports to the latter without delay all orders relating to the guard not given or transmitted by the officer of the deck; he transmits to his successor all information relating to his duties.

(2) He will inspect his guard at sunset, and will then perfect its orders and dispositions for the night.

(3) He will inspect the reliefs at 8.00 a. m. and at 8.00 p. m., and at other times ordered. He will see that the reliefs are posted every two hours, excepting the dinner and supper reliefs, which are to be posted at 12.30 p. m. and not later than 6.30 p. m.

(4) He will question his petty officers and sentinels relating to the instructions they may have received from the *old* guard; he will see that patrols and visits of inspection are made as directed by the executive officer.

(5) He will see that the orders of each sentinel and orderly are bulletined on each post.

(6) Should a member of the guard be incapacitated from any cause he will call upon the man's division officer for a relief. He will enter in the guard report a record of his tour of duty, and, on the completion of his tour, will present it to the executive officer. He will inspect the brig spaces and cells at least once during his tour of duty, and at such other times as he may deem necessary. He will require the chief master-at-arms to report to him after each meal that all meals sent to the brigs are, in quantity and quality, in accordance with regulations.

(7) Before guard mount he will report to the officer of the deck the names of all men undergoing punishment whose terms of confinement expire that day.

(8) Before guard mount the *old* and the *new* officer of the guard will together inspect and visit the posts.

(9) The *new* officer of the guard will receipt to the *old* officer of the guard, in the guard report, for the articles under charge of the guard. After guard mount both officers of the guard report to the executive. On presenting themselves both salute. The *old* officer of the guard, standing on the right of the *new*, presenting the guard report, says, *Sir, I report as the old officer of the guard.* As soon as the executive officer notifies the *old* officer of the guard that he is relieved, the *new* officer of the

guard says, *Sir, I report as the new officer of the guard*, and then receives his instructions.

622. The chief petty officer of the guard (the chief master-at-arms).—

(1) Before guard mount he will prepare triplicate lists of all the petty officers and men of the guard, showing the assignments to reliefs and the number of the relief. The petty officers will be assigned to reliefs in order of seniority, so that the senior is the petty officer of the first relief, and so on. One list will be handed as soon as practicable to the officer of the guard. The other two lists will be separated into reliefs, and these furnished in duplicate to the petty officers of the guard, who will report to the chief master-at-arms immediately after breakfast for them. The "first relief" goes on post at guard mount till 10.00 a. m.; then is followed in regular order by the second, third and fourth reliefs. He will see that the petty officers of the guard thoroughly understand, and are prompt and efficient in the discharge of their duties.

(2) After morning quarters he will proceed to the executive's office and obtain the guard report.

(3) He will report to the officer of the guard all delinquencies among any men whatever that come under his notice.

(4) Under the direction of the officer of the guard he will see that the compartment division petty officers carry out the lower decks routine and the general messmen's routine.

(5) He is responsible that the special orders for the petty officers of the guard, and for the sentinels and orderlies, are bulletined where designated by the executive officer; and that the copies are up to date as to changes that may from time to time be ordered in such special orders. He is responsible that authenticated copies of all special orders are posted in the guard report.

623. Petty officers of the guard.—

(1) Petty officers of the guard are assigned to reliefs by the chief petty officer of the guard (the chief master-at-arms).

(2) A petty officer of the guard receives and obeys orders from none but petty officers of the guard senior to himself, the chief petty officer of the guard, the officer of the guard, the officer of the deck and the commanding (executive) officer.

(3) It is the duty of the petty officer of the guard to post and relieve sentinels, and to instruct the members of his relief in their orders and duties.

(4) Immediately after the petty officers receive the lists of their reliefs from the chief master-at-arms, they will assign the men of their respective reliefs to posts by number, and a man so assigned to a post will not be changed to another post during the same tour of guard duty, unless by orders of the officer of the guard.

(5) Each petty officer will then enter on his lists the assignments of the men to posts, and will return one copy to the chief master-at-arms, retaining the other for his own use.

624. General duties of petty officer of the guard on post.—

(1) The petty officer of the guard whose relief is on post generally will remain accessible to the officer of the deck, although his post extends throughout the ship.

(2) He will thoroughly acquaint himself with all the special orders of every orderly and sentinel on his relief, and will see that each sentinel correctly transmits such orders in detail to his successor.

(3) He will see that each sentinel and orderly on being posted clearly understands the limits and extent of his post.

(4) When the ship is at anchor he will exercise supervision over all ship's gangways, and will report to the officer of the deck shore boats coming alongside. He will see that no property is passed over the gangway unless authorized.

(5) He will inspect the orderlies and sentinels every half hour.

(6) He will at once report to the officer of the guard any unbecoming conduct on the part of a sentinel or orderly on post.

(7) He will at once report to the officer of the deck any violation of Regulations or any unusual occurrence reported to him by a sentinel, or coming to his notice in any other way, will arrest the offender and bring him to the officer of the deck.

(8) Each petty officer of the guard is responsible for turning out the men of his own relief for the night watches, and he will wake the petty officer whose relief is next on post in time for the latter to form his relief and post it promptly.

(9) Should the guard be turned out during the night watches each petty officer will call the men of his own relief, and cause his men to fall in promptly.

(10) The petty officers of the guard will acquaint themselves with the billets of the men of their own reliefs. The guard should be billeted together.

(11) Between tattoo and reveille the petty officer of the guard will challenge all boats approaching the ship with the challenge **BOAT AHOY**.

(12) The petty officer of the guard will salute all officers, whether by day or night.

(13) The petty officers of the guard will not remove their accoutrements or clothing during their tour of guard duty, and will not absent themselves from the vicinity of the guard headquarters except for meals and for short, necessary absences.

625. Men of the guard.—

(1) Men of the guard will not remove their accoutrements or clothing during their tour of guard duty, and will not absent

themselves from the guard headquarters except on permission from their own petty officer.

(2) During his tour of guard duty a man is subject to the orders of the commanding (executive) officer, the officer of the deck, the officer and petty officers of the guard only.

(3) Men are assigned to reliefs by the chief petty officer of the guard (the chief master-at-arms), and to posts by the petty officer of the relief. They will not change from one post or relief to another during their tour of duty unless so ordered by the officer of the guard.

(4) Men of the guard supernumerary to those required for the regularly established posts are available for such temporary and special posts that may be required, for shore patrol or beach guard duty. When a ship becomes due for shore patrol or beach guard duty, the strength of the guard for that day should be temporarily augmented for the duty.

626. Orders for sentinels and orderlies on post.—Orders for men on post are divided into two classes, *general orders* and *special orders*. All men liable for guard duty will be required to memorize the following:

GENERAL ORDERS.

My general orders are:

(1) To take charge of this post and all Government property in sight.

(2) To walk my post in a military manner, keeping on my feet and constantly alert, observing everything that takes place within sight or hearing.

(3) To report every breach of orders or Regulations that I am instructed to enforce.

(4) To quit my post only when properly relieved.

(5) To receive, transmit and obey all orders from, and to allow myself to be relieved by, the commanding (executive) officer, officer of the deck, officer of the guard, or a petty officer of the guard.

(6) To hold conversation with no one except in the proper discharge of my duty. To read nothing on post except my general and special orders.

(7) To learn my special orders.

(8) In case of fire or disorder to give the alarm by singing out *Petty officer of the guard, Post No. —*.

(9) To salute all officers, passing boats carrying officers and passing ships of war.

(10) Between tattoo and reveille to exercise the greatest vigilance.

(11) In any case not covered by instructions to call the petty officer of the guard.

GUARD MOUNTING.

627. In fair weather.—Guard mount shall be held on the quarter deck. The guard and the band parades should be designated so that, after the review, the band and the *new* guard will remain formed in the customary place for rendering side honors.

628. In foul weather.—The band will not be called. The parade for guard mount should be lower deck space, designated at or near the headquarters of the officer of the guard.

629. The accoutrements of the guard.—Sufficient arms and equipment for both *old* and *new* guard should be kept in a guard chest near the headquarters of the officer of the guard; rifles in a specially prepared rack. A detail from the guard of the day should scrub (if necessary) the belts when turned in by the *old* guard.

630. The call.—The call for guard mount (*Call No. 61*) will be sounded at "turn to" after breakfast. At the call the *new* guard assembles at the guard chest, and under the direction of the senior petty officer, *new* guard equips with arms and accoutrements.

631. The formation.—

(1) Fifteen minutes after the call *guard mount*, the *full guard* call (*No. 15*) and (if the guard mount is on the weather decks) the *band* call (*No. 14*) will be sounded.

(2) At this call, the band, the *old* guard and the *new* guard form, facing to port, on the weather deck; the band forward, the *old* guard aft, the *new* guard between the band and *old* guard.

(3) Both guards form by reliefs, the lowest numbered relief on the right. The petty officer of the right relief is the right guide, the petty officer of the left relief is the left guide, the petty officer of the right center relief and the left center relief in the rear of their reliefs.

(4) Both guards are formed and mustered by the senior petty officer as for school of the company.

(5) Each officer of the guard then commands 1. *Open ranks*; 2. *MARCH*; 3. *FRONT*; and proceeds to inspect his guard. (If under arms, the inspection follows the manual on the command 4. *Inspection*; 5. *ARMS*.)

(6) The band here plays an air.

(7) The inspection ended, each officer of the guard closes ranks.

(8) The officers of the guard then face each other, salute (or present), and the *new* officer of the guard says, *Sir, I will relieve you*.

(9) The *old* officer of the guard brings the *old* guard to parade rest, faces about and comes to the parade rest. The *new* officer of the guard faces his guard and commands *Post the relief*.

(10) The petty officer of the first relief, *new guard*, takes one step to the front, faces right and commands to his relief 1. *Right*; 2. *Face*; 3. *Forward*; 4. *MARCH*; and as the relief passes him the petty officer takes up the march on the left of the rear file. The petty officer of the *old guard* places himself on the right of the leading file and takes command when the last one of the *old* sentinels is relieved, changing places with the petty officer of the *new guard*.

(11) The band leader here ceases playing and moves his band to the front and left to the point habitually occupied by the band in rendering side honors, and prepares to play a march.

(12) As soon as the first relief of the *new guard* has moved off the petty officer of the second relief, *new guard*, takes post as the right guide of the *new guard*; and the officer of the *new guard* commands to his guard 1. *Right*; 2. *Face*; 3. *Forward*; 4. *Column left*; the officer of the *old guard* brings his guard to attention, and the officer of the *new guard* commands 5. *MARCH*. (If under arms and on the weather deck, the *new guard* should first be brought to the *shoulder arms*); and conducts his guard along the front of the *old guard* from its right.

(13) The band here plays a march.

(14) When the head of the *new guard* reaches the right of the *old guard* the officer of the *new guard* commands 1. *Eyes*; 2. *LEFT*; and himself executes the salute. The officer of the *old guard*, facing his guard, commands 1. *Hand*; 2. *SALUTE*; faces about and executes the salute. (If under arms and on the weather deck, the command to the *old guard* should be 1. *Present*; 2. *ARMS*.)

(15) When the rear of the *new guard* reaches the left flank of the *old guard* the officer of the *new guard* commands 3. *FRONT*; and the officer of the *old guard*, facing his guard, commands 3. *Two* (or 3. *Order*; 4. *ARMS*).

(16) The band here ceases playing.

(17) The *new guard* arriving two paces from the left of the band, the officer of the *new guard* commands. 1. *Guard*; 2. *HALT*. 1. *Left*; 2. *FACE*. 1. *DISMISS THE GUARD AND BAND*. (If under arms and on the quarter deck, the arms of the *new guard* should first be stacked.)

(18) The officer of the *old guard* conducts his guard to the guard chest, and, after turning in and accounting for the arms and accoutrements of the *old guard*, disbands the *old guard*.

(19) When the *old* relief arrives at the guard chest the arms and accoutrements are turned in and accounted for in the presence of the petty officer of the first relief, *new guard*; and the *old* relief is disbanded.

632. To post and dismiss a relief.—Follow the tactics in the Manual of Guard Duty, page 145, The Landing Force Manual, 1912.

633. General instructions.—

(1) At quarters for muster in fair weather, the guard of the day falls in at the point where the guard assembles for rendering side honors. In foul weather the guard of the day falls in at the guard chest.

(2) At all emergency drills the guard of the day assembles as above.

(3) At division drills and exercises the guard is dismissed to the divisions on the drill call; the relief on posts is relieved by the chief master-at-arms and the designated drill reliefs.

(4) At battle drills the guard answers the battle drill calls directly; the relief on posts being relieved by the petty officer of the guard, and by him dismissed to the divisions.

(5) On the retreat from drills and exercises the guard call is to be sounded, the guard assembled, the posts re-established and the relief posted.

634. Detailed instructions.—See Landing Force and Small-Arms Instructions, 1912; Part II, Manual of Guard Duty, which, where not modified and abridged in the foregoing, should govern guard duty.

PART VII

PHYSICAL EXERCISES

	PAGE
SWORD EXERCISE	185
BAYONET EXERCISE	194
PHYSICAL DRILL WITH ARMS.....	203
PHYSICAL DRILL WITHOUT ARMS.....	210

PHYSICAL EXERCISES.

SWORD EXERCISE.

NOTE.—From Ship and Gun Drills, 1905. Originally prepared by Sword Master A. J. Corbesier, U. S. Naval Academy, assisted by Lieut. W. F. Fullam, U. S. N.

It is inserted in this book to serve as a guide to officers or men who desire to perfect themselves in the use of the sword as a weapon.

701. General remarks.—(1) In this exercise attacks are made by thrusting with the point of the sword, or by cutting with the edge. The attack with the point is usually more deadly, and there is less exposure to counter attack than there is in making the slashing blows that alone render the edge effective; both methods may, however, be used; circumstances must determine.

(2) For instruction, the men form in one or two ranks facing to the front, swords at the *order*; intervals and distances are taken as in the drill regulations; swords are brought to the *carry* at the preparatory command for marching, and are brought to the *order* on halting.

(3) In the exercise, the sword is held in the right hand, thumb along the back of the gripe and almost touching the guard, the fingers united underneath, holding the hilt rather loosely.

(4) Movements that may be executed in the same general manner toward either flank, are explained as toward but one flank, it being necessary to substitute the word *left* for *right*, or the reverse, to have the commands and explanation for the corresponding movement toward the other flank.

702. The moulinets.—1. *Sword exercise*, 2. MOULINET. At the first command, raise the sword to the height of the right shoulder, edge to the right, back of the hand up, arm ex-

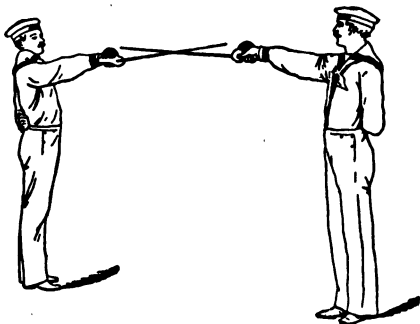


Plate 1. The moulinet; first position.

tended to the front; at the same time make a half face to the left, the right toe square to the front, feet at right angles, heels together, and carry the left hand to the small of the back, body erect, eyes to the front. At the second command, drop the point to the left and describe a full circle without bending the arm, the sword grazing the left shoulder, opening the fingers to give play to the hilt, and resume the original position; then reverse the hand, finger nails up, edge to the left, and execute a moulinet to the right of the body in a similar manner, continuing the moulinets alternately. At the command: 1. *Order*, 2. *SWORDS*, resume the *order*. (Plate 1.)

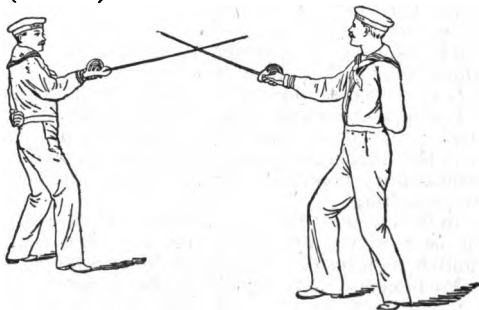


Plate 2. Right guard.

703. The guards.—1. *Sword exercise*, 2. *GUARD*. (1) The first command is executed as in the moulinets. At the second command, bend the forearm, and bring the hand to the height of the right nipple and in front of the right shoulder, the elbow free from the body and slightly outside the hip, the point of the sword at the height of the chin, edge to the right; at the same time advance the right foot twice its length, bend both knees slightly,

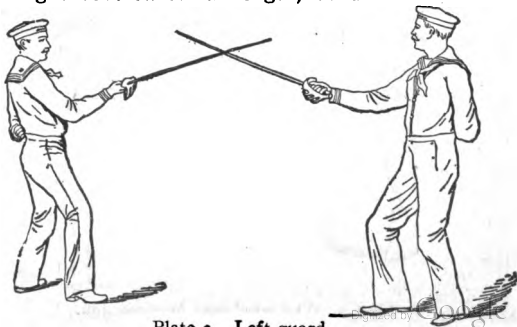


Plate 3. Left guard.

body erect, the weight thrown a little more on the left leg than on the right, head erect, eyes to the front. This is the position of *right guard*. In the *left guard*, the sword is held edge to the left, finger nails up, the hand opposite the center of the body. (Plates 2 and 3.)

(2) To change guard: 1. **CHANGE GUARD.** Reverse the position of the hand, raising the point and drawing the hand back slightly, to pass over, and close to, the point of the opponent's sword.

(3) The attacks and parries, to the left, are made from the position of *right guard only*, and vice versa.

(4) The *head* and *thrust attacks* and *parries* are made from the *right guard only*.



Plate 4. Head attack and parry.

704. The steps.—1. **ADVANCE** (or **RETIRE**); or, 1. *Step right* (or *left*), 2. **STEP.** Executed as in the bayonet exercise. In the engagement and assault, one opponent advances when the other retires, and one steps to the right when the other steps to the left.

705. The parries.—1. *Head*, 2. **PARRY.** (1) Carry the point of the sword a little to the right, then drop it to the left and raise the sword quickly a few inches above the head, edge up, hand in front of the right ear, the point to the left, the sword inclined slightly downward. (Plate 4.)

(2) 1. *Right* (or *left*) *cheek* (or *neck*), 2. **PARRY.** Carry the hand about ten inches in front and three inches to the right of the right cheek, edge to the right, point up, sword inclined slightly to the front. For the *neck parry*, lower the hand a few inches. (Plates 7 and 8.)

(3) 1. *Right flank*, 2. **PARRY.** Describe a semi-circle from left to right with the point of the sword until it is a little to the

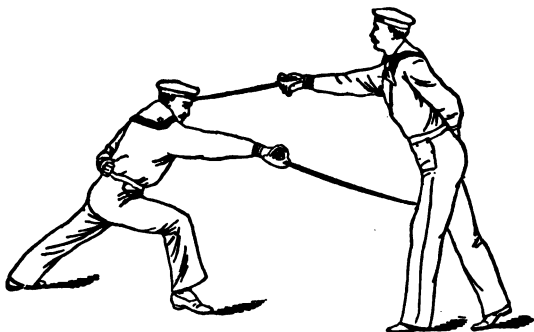


Plate 5. Leg attack; left cheek return.

right of the right knee, edge to the right, the hand to the right of the right hip and five inches below the right nipple, arm slightly bent. (Plate 10.)

(4) 1. *Left flank*, 2. PARRY; or, 1. *Thrust*, 2. PARRY. Carry the point of the sword slightly to the right, then drop the point to the left, the blade in line with the left knee and slightly to the front, sword edge to the left, the elbow and hand about the height of the breast. (Plates 9 and 11.)

(5) Attacks at the leg are not parried with the sword, but by moving the right toe to the rear of the left heel, legs extended; at the same time carry the upper part of the body forward and attack the opponent's head or cheek. This movement will be executed at the command: 1. *Right foot to the rear*, 2. *Head* (or *Right*, or *Left cheek*), 3. ATTACK. (Plates 5 and 6.)

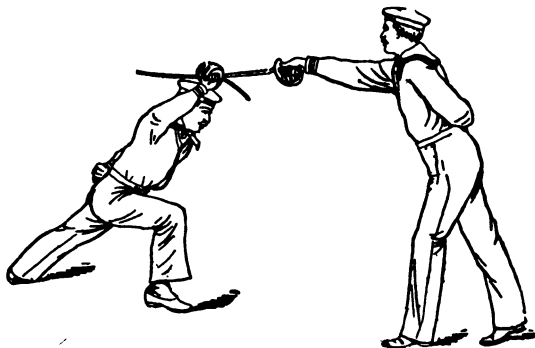


Plate 6. Leg attack; head return.

706. Single attacks.—(1) All single attacks are made in two motions, the first motion being to disengage and extend the arm quickly in the direction of the attack; the second motion is a *lunge* and quickly follows the first.

(2) The command, *attack* (or *return*), is the signal for the first motion, and the command, *lunge*, for the second motion.

(3) A *feint* is made by omitting the second motion, or lunge.

(4) In all attacks, except the *thrust*, disengage by drawing back slightly and reversing the hand, the point passing over and close to the opponent's sword, and then extend the arm quickly.

(5) In the *thrust attack*, disengage by dropping the point below and to the opposite side of the opponent's sword, and reverse the hand, if the guard is to the left; if the guard is to the right, the hand is not reversed.

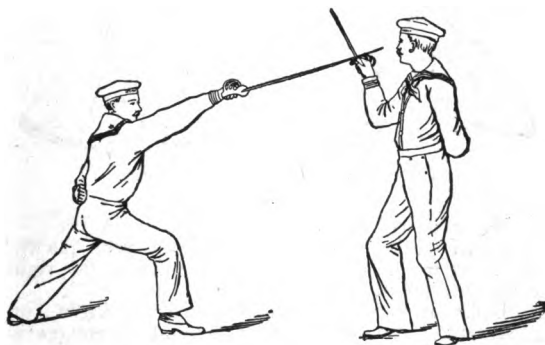


Plate 7. Right cheek attack and parry.

(6) Having executed the first motion of an attack: **LUNGE.** Carry the right foot forward about eighteen inches, grazing the ground; extend the left leg, body thrown slightly forward, head thrown slightly back, left hand remaining at the small of the back.

(7) The *lunge* will be executed in all attacks. In making an attack, the right hand is held as best to oppose a counter attack.

(8) To resume the guard: **GUARD.** Bend the left knee, carry the right foot quickly to its original position, throwing the weight of the body on the left leg, and resume the *guard*.

(9) Being at the right guard: 1. *Head*, 2. *ATTACK*. At the second command, throw the sword point slightly to the rear to clear the point of the adversary's sword and extend the arm quickly; sword edge down, and attack the forehead of the adversary, hand at the height of the shoulder. (Plate 4.)

(10) Being at the left or right guard: 1. *Right* (or *Left*) *cheek* (or *neck*), 2. **ATTACK.** At the second command, disengage and extend the arm quickly, sword at the height of the cheek, or neck, edge to the right, and point directly for the middle of the face, or neck. (Plates 7 and 8.)



Plate 8. Left cheek attack and parry.

(11) Being at right guard: 1. *Thrust*, 2. **ATTACK.** At the second command, disengage and extend the arm quickly, point of the sword at the height of the breast, edge to the right, hand opposite the left breast. (Plate 9.)

(12) Being at the left or right guard: 1. *Right* (or *Left*) *flank*, 2. **ATTACK.** At the second command, disengage and ex-



Plate 9. Thrust attack and parry.

tend the arm quickly, lower the point to the height of the belt, edge to the right, and point at the flank. (Plates 10 and 11.)

(13) After all attacks for the face, neck or body, press with the thumb on the hilt and then withdraw the sword in an oblique direction to obtain a clear cut.

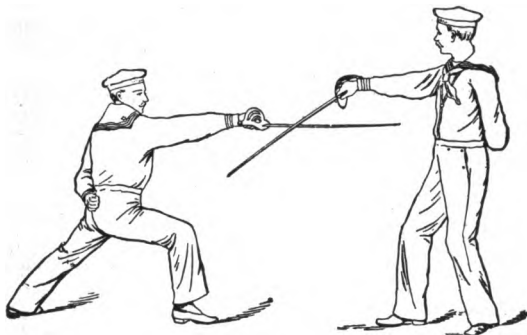


Plate 10. Right flank attack and parry.

(14) The parries and attacks are first taught separately and afterwards in combination, thus:

1. *Head*, 2. *PARRY (or ATTACK)*, 3. *GUARD*, etc.
1. *Head*, 2. *ATTACK*, 3. *LUNGE*, 4. *GUARD*, etc.
1. *Left cheek*, 2. *ATTACK*, 3. *LUNGE*, 4. *Right flank*, 5. *PARRY*, 6. *GUARD*, etc.

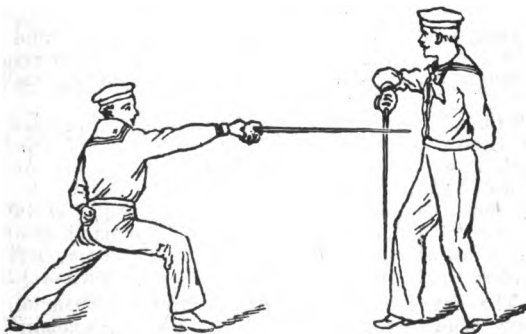


Plate 11. Left flank attack and parry.

707. Returns.—(1) The attacks from the positions of the parries are called *returns*, and are made as follows: After the head parry: 1. *Head* (or *Left cheek, neck* or *flank*), 2. RETURN. At the second command, describe a quarter-circle with the point above the head from left to right by way of the rear without disturbing the position of the hand; when the sword points directly to the rear reverse the hand, bringing the edge to the left, extend the arm quickly and finish the movement as for the head, cheek, neck, or left flank attack.

(2) After the cheek or neck parry: 1. *Right* (or *Left*) *cheek, (neck* or *flank)*, 2. RETURN. Throw the point slightly to the rear to clear the point of the opponent's sword, then quickly turn the back of the hand up (or down) and attack in the designated direction.

(3) After the right flank parry: 1. *Thrust*, 2. RETURN.

(a) Raise the hand, nails down, extend the arm quickly and thrust for the face or upper part of the body.

(b) To parry this return, raise the sword point to the left and take the *head parry*.

(4) After the left flank parry or thrust parry: 1. *Head*. 2. RETURN. At the second command, execute a left moulinet and attack the forehead of the adversary, sword edge down, hand at the height of the shoulder.

(5) The parries, attacks, and returns will next be taught in combination thus:

1. *Left flank*, 2. PARRY, 3. *Head*, 4. RETURN, 5. LUNGE, 6. GUARD.

1. *Thrust*, 2. ATTACK, 3. LUNGE, 4. *Head*, 5. PARRY, 6. GUARD.

1. *Head*, 2. ATTACK, 3. LUNGE, 4. *Left cheek*, 5. PARRY, 6. *Right flank*, 7. RETURN, 8. LUNGE, 9. GUARD, etc.

708. Compound attacks and returns.—A compound attack, or return, consists of a *feint* followed by an *attack* or *return*, and will be taught after proficiency is attained in single attacks. For example:

(1) Being at right guard: 1. *Left and right cheek*, 2. ATTACK, 3. LUNGE, 4. GUARD. At the second command, *feint* for the left cheek, at which the opponent begins to *parry left cheek*; then reverse the hand quickly and attack the right cheek.

(2) Being at head parry: 1. *Left and right cheek*, 2. RETURN, 3. LUNGE, 4. GUARD. At the second command, *feint* for the left cheek, at which the opponent begins to *parry left cheek*; then reverse the hand quickly and attack the right cheek.

709. The engagement.—(1) After careful instruction in the foregoing principles and movements, the engagement will be taught. The men will form in two ranks, take intervals, and the front rank will then be faced about.

(2) At the command, *Sword exercise!* the front-rank men, in executing the movement, will place themselves in front of their rear-rank men, and at such a distance that the swords will overlap about six inches when on guard.

(3) In the engagement, the opponents' swords will be held edge to edge when on guard.

(4) The rank to attack will be designated in the command; the rank attacked will execute the *parry* and *return*.

(5) The *parry* will always be taken at a *feint*, or at the first motion of an attack.

710. Examples in single attacks.—(1) 1. *Front* (or *Rear*) rank, 2. *Step right*, 3. STEP. At the third command the designated rank executes *Step right*, and the other rank *Step left*.

(2) 1. *Front* (or *Rear*) rank, 2. *Head*, 3. ATTACK, 4. LUNGE, 5. GUARD. At the third command, the designated rank will *attack*, and the other rank will *parry*.

711. Examples in single attacks and single returns.—1. *Front* (or *Rear*) rank, 2. *Head*, 3. ATTACK, 4. LUNGE, 5. *Left cheek* (or *neck*), 6. RETURN, 7. LUNGE, 8. GUARD. At the third command, the designated rank will *attack*, and the other rank will *parry*. At the sixth command, the rank attacked will *return*, and the opposing rank will *parry*.

712. Examples in compound attacks and single returns.—1. *Front* (or *Rear*) rank, 2. *Left and right cheek*, 3. ATTACK, 4. LUNGE, 5. *Left cheek*, 6. RETURN, 7. LUNGE, 8. GUARD. At the third command, the designated rank will *feint* and *attack*, and the other rank will *parry left and right cheek*. At the sixth command, the rank attacked will *return*, and the opposing rank will *parry*.

713. Examples in single attacks and compound returns.—1. *Front* (or *Rear*) rank, 2. *Head*, 3. ATTACK, 4. LUNGE, 5. *Left and right cheek*, 6. RETURN, 7. LUNGE, 8. GUARD.

714. Example in compound attacks and compound returns.—(1) 1. *Front* (or *Rear*) rank, 2. *Right and left cheek*, 3. ATTACK, 4. LUNGE, 5. *Right and left cheek*, 6. RETURN, 7. LUNGE, 8. GUARD.

(2) To repeat a movement, the commands of execution alone need be repeated; for example, to repeat the last movement: 1. ATTACK, 2. LUNGE, 3. RETURN; 4. LUNGE, 5. GUARD.

715. The assault.—(1) After careful instruction in all the principles and movements of the engagement, the instructor may permit the men to engage *at will* at the command, *assault*, provided that an outfit of masks is supplied for this purpose. The men must be cautioned to move the hand and sword as little as possible from the position of *guard*, in order to keep themselves

covered; to watch the hand of the opponent instead of his eyes, and to attack close to his sword.

(2) To discontinue the engagement or assault, the instructor will command: 1. *Order*, 2. **SWORDS**, at which the men will resume the *order*.

(3) The men are assembled as in the drill regulations.

716. To dismiss.—Having assembled: 1. *Carry*, 2. **SWORDS**, 3. **DISMISSED**.

BAYONET EXERCISE.

NOTE.—Prepared by Sword Master A. J. Corbesier, U. S. Naval Academy. From *Ship and Gun Drills*, 1905, with slight additions.

717. To take intervals or distance.—Intervals or distances are taken as prescribed in the drill regulations.

718. The guard.—(1) Intervals or distances having been taken, and the squad being at the *order*, bayonets fixed, the instructor commands: 1. *Bayonet exercise*, 2. **GUARD**. At the first com-

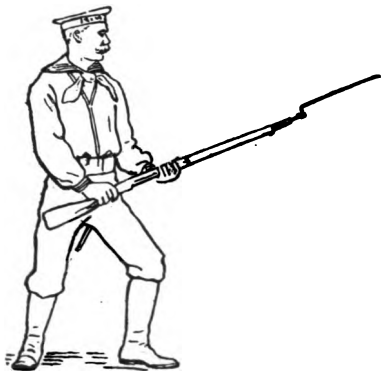


Plate 12. The guard.

mand, pieces are brought to the *port*; at the second command, half face to the right, carry back and place the right foot about twice its length to the rear, the hollow of the right foot in the rear of the left heel, the feet at a little less than a right angle, the right toe pointing to the right, both knees slightly bent, body erect on the hips, the weight thrown a little more on the right leg than on the left; at the same time throw the point of the bayonet to the front, at the height of the chin, barrel to the left, the small of the stock directly in front of the center of the body below the belt, the left hand below the sight with the thumb along the barrel, both arms free from the body, without constraint. (Plate 12.)

(2) Being at guard: 1. *Order*, 2. *ARMS*. Resume the *order* as from *charge bayonet*.

719. *The steps*.—(1) *ADVANCE*: Move the left foot quickly forward eight inches; follow with the right foot the same distance.

(2) *RETIRE*: Move the right foot quickly to the rear eight inches; follow with the left foot the same distance.

(3) 1. *Step right*, 2. *STEP*: Move the right foot quickly to the right eight inches; follow with the left foot to its relative position in front.



Plate 13.
Facings. First position.



Plate 14.
Right low parry.



Plate 15.
Left low parry.

(4) 1. *Step left*, 2. *STEP*: Move the left foot quickly to the left eight inches; follow with the right foot to its relative position in rear.

(5) 1. *Front*, 2. *DOUBLE*: Advance the right foot quickly eight inches in front of the left, keeping the right toe to the right; then advance the left foot to its relative position in front.

(6) 1. *Rear*, 2. *DOUBLE*: Carry the left foot quickly eight inches to the rear of the right; then place the right foot in its relative position in rear.

720. *The facings*.—(1) 1. *Face right* (or *left*), 2. *FACE*: At the first command, bring the piece quickly to the *port*; at the second command, face to the right, turning on the ball of the left

foot, at the same time carry the right foot quickly to its relative position in rear and resume the *guard*. (Plate 13.)

(2) 1. *Right* (or *Left*) *about*, 2. *FACE*: Similarly executed, facing about on the ball of the left foot.

(3) The foregoing movements are first executed without arms, hands on hips, fingers to the front, thumbs to the rear, elbows pressed back.

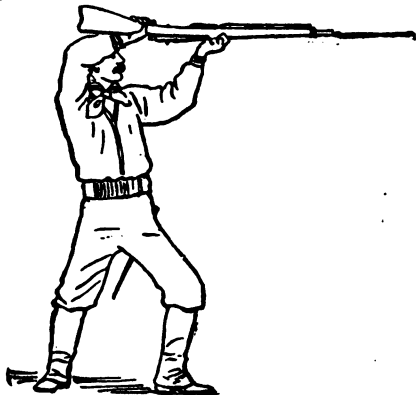


Plate 16. High parry.

721. The parries.—(1) In the preliminary drills, after the *parries* and *thrusts*, the position of *guard* is resumed by the command, *GUARD!* after each movement.

(2) 1. *Right* (or *Left*), 2. *PARRY*: Move the point of the bayonet quickly about six inches to the right.

(3) 1. *Right low*, 2. *PARRY*: Raise the butt outside the right forearm, the right hand at the height of the breast; at the same time describe a semi-circle from left to right with the point of the bayonet until it is at the height of, and a little to the right of, the right knee; barrel to the left. (Plate 14.)

(4) 1. *Left low*, 2. *PARRY*: Lower the point of the bayonet, describing a semi-circle, and carry it to the left at the height of, and a little to the left of, the left knee; barrel to the left, the right hand opposite the left breast. (Plate 15.)

(5) 1. *High*, 2. *PARRY*: Raise the piece quickly with both hands, the right hand three inches in front of, and four inches above, the head; the barrel down and supported between the thumb and forefinger of the left hand above the sight, the piece directed to the front with the point of the bayonet opposite the left shoulder; at the same time bend both knees slightly more than in the position of *guard*. (Plate 16.)

(6) 1. *High right (or left)*, 2. PARRY: Executed in the same manner as the *high parry*, except that the left shoulder is advanced, and the point of the bayonet directed to the right. (Plate 17.)

(7) In the different *parries*, the pieces should be so held as to cover the point attacked. When the men have become proficient, they will be instructed to resume the *guard* without command.

722. The thrusts.—(1) 1. *Straight*, 2. THRUST: Carry the upper part of the body forward, advance the right shoulder, straighten the right leg, and bend the left knee; at the same time thrust the piece directly to the front to the full length of the right arm, slipping it through the left hand, barrel up, the bayonet and the butt at height of the chin. (Plate 18.)

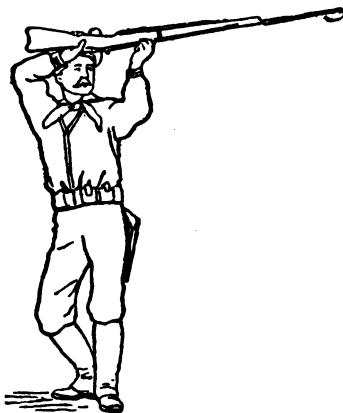


Plate 17. High left parry.

(2) The *straight thrust* should be executed frequently in order to strengthen the wrist. It may be executed directly from the *guard*, or from the *right and left parries*, and the *guard* should be resumed promptly to keep control of the piece. In *thrusting*, the piece must be held so as to cover the point most exposed to the enemy's attack.

(3) The *thrusts* from the different *parries* are made with the right leg always straightened, and the body carried forward as in the *straight thrust*.

(4) 1. *Right (or Left)*, 2. PARRY, 3. THRUST, 4. GUARD. Execute the *straight thrust*.

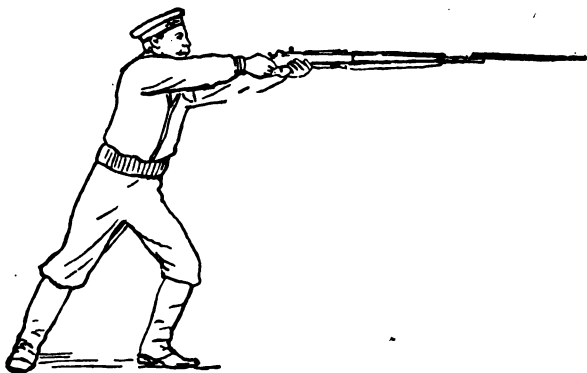


Plate 18. Straight thrust.

(5) 1. *Right low*, 2. PARRY, 3. THRUST, 4. GUARD. Thrust to the full extent of the left arm, barrel to the left, bayonet at the height of the waist, right hand at the height of the breast, keeping the left hand fast, stock outside the right forearm. (Plate 19.)

(6) 1. *Left low*, 2. PARRY, 3. THRUST, 4. GUARD. Thrust to the full extent of the left arm, barrel to the left, bayonet at the height of the waist, right hand at the height of the breast, keeping the left hand fast, stock outside the right forearm.

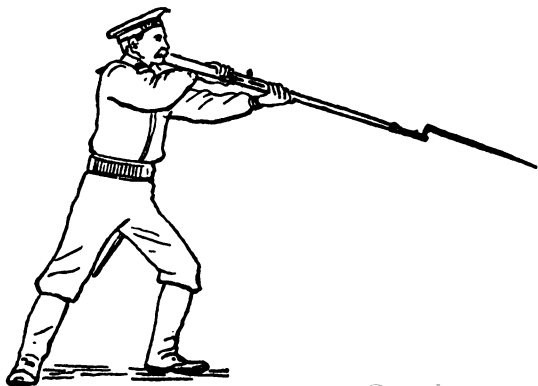


Plate 19. Right low thrust.

(7) 1. *High* (or *High right*, or *High left*), 2. *PARRY*, 3. *THRUST*, 4. *GUARD*. Thrust in the designated direction to the full extent of the left arm, barrel down, right hand above, and in front of, the head, keeping the left hand fast.

(8) The command for the *thrust* quickly follows the *parry*.

(9) In the same manner a *thrust* may be executed directly from the position of *guard*, in the direction of any *parry*, by one command: 1. *High*, 2. *THRUST*, 3. *GUARD*; or, 1. *Right low*, 2. *THRUST*, 3. *GUARD*, etc. (Plate 20.)

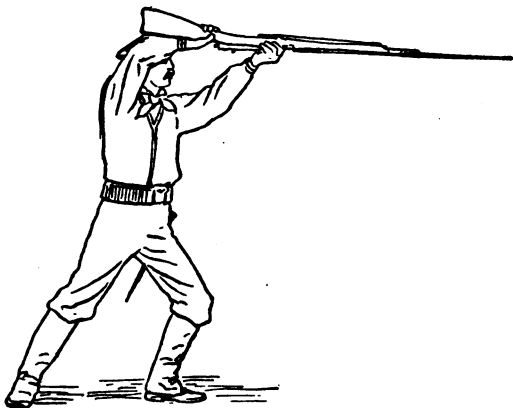


Plate 20. High thrust.

(10) 1. *Low right*, 2. *SHORT*: Throw the body backward, straighten the left leg and bend the right knee; at the same time draw the piece back quickly to the full length of the right arm, lowering the butt about six inches below the right hip, slipping the left hand up to the upper band, barrel up, left hand at the height of the hip, right hand at small of the stock. (Plate 21.)

(11) 1. *Low right*, 2. *SHORT*, 3. *THRUST* (or *STRAIGHT THRUST*): Throw the body forward on the hips, straighten the right leg, and bend the left knee; at the same time thrust the piece forward quickly to the full length of the left arm without moving the hands, barrel up, both hands at the height of the waist. (Plate 22.)

(12) Should the adversary retreat, the *straight thrust* must be used.

(13) Being at low right short: to *parry*, move the point of the bayonet as in *right* or *left parry*, without moving the hands.

723. To use the butt.—(1) *BUTT TO FRONT*: Raise the piece nearly vertical and bring it back, barrel in the hollow of right



Plate 21. Low right short.

shoulder, strike quickly the butt to the front, straighten the right leg, barrel resting on the shoulder. (Plate 23.)

(2) BUTT TO RIGHT (OR LEFT): Face right (or left) and proceed as in *butt to front*. In resuming the *guard*, face left (or right).

(3) BUTT TO REAR: Turn to the right on both heels, keeping the feet nearly at a right angle, right toe to the rear, at the same time raise the piece over the left shoulder, barrel down and horizontal, back of right hand against left side of neck, left hand near lower hand, left leg straight; strike quickly the butt to the rear. (Plate 24.)



Plate 22. The low right short thrust.

(4) In resuming the *guard*, turn to the left on both heels, and bring the left toe to the front.

724. To change guard.—(1) 1. *Change guard*, 2. *REAR*: Turn to the right on both heels, raising the toes, and face quickly to the rear; at the same time raise the point of the bayonet in a semi-circle, and throw the piece to the rear, releasing it for an instant with both hands and then grasp it again with the hands interchanged, the right hand below the sight and the left at the small of the stock, the barrel to the right in the position of *guard*. (Plate 25.)

(2) The *parries* and *thrusts*, *facings*, *steps*, and other movements may then be executed according to the foregoing principles.

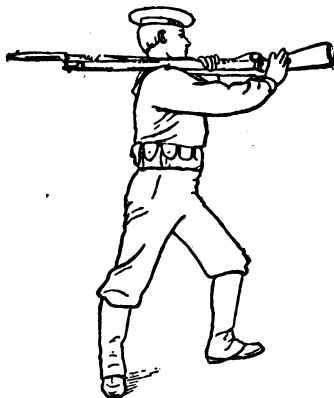


Plate 23. Butt to front.

(3) To resume the original front, the commands are the same, and the movement is executed in a similar manner.

725. Combinations.—(1) When the recruits are thoroughly familiar with the different *steps*, *parries*, and *thrusts*, the instructor combines several of them by giving the commands in quick succession, increasing the rapidity and number of movements in combination as the men acquire skill: *ADVANCE, HIGH PARRY, THRUST*; or *FRONT DOUBLE, RIGHT PARRY, THRUST*; *FACE LEFT, HIGH PARRY, THRUST*, etc.

(2) The *guard* is resumed without command.

(3) Every movement to the front should be followed by a *thrust*; every movement to the rear by a *parry*.

(4) The cautionary command, *attack*, may be used preceding a combination of movements.



Plate 24.
Butt to rear.



Plate 25.
Change guard rear.

(5) To repeat a combination, the numerals *one, two, three*, etc., may be used instead of repeating the commands.

(6) It is intended merely to prescribe the manner of executing the movements laid down, but not to restrict the number of movements, leaving to the discretion of c. cs. and the ingenuity of instructors the selection of such other exercises as accord with the object of the drill.

(7) As soon as the movements are executed accurately, the commands are given rapidly, expertness in the bayonet exercise depending mostly on quickness of motion.

726. Bayonet fighting.—(1) The man-o'-war'sman should understand the *application* of the foregoing in attack and defense. To that end men must engage in the *assault*. This requires masks, padded clothing, padded gloves, dummy rifles and spring dummy bayonets. As a preliminary, men should practice the thrusts at a wall pad or suspended dummy; first from a stand, second approaching at a walk, and third approaching at the "double." Practice in the use of the butt in attack at close quarters should also be had against the dummy.

(2) A half-hearted bayonet attack is dangerous only to the attacker. The attack must be resolute, rapid and pushed well home. Even if an attack which has been delivered with determination and energy is parried, the very resolution with which it was delivered tends to so upset the adversary that he is unable to return. There should be a quick recovery after an attack, and a quick return when attacked.

727. Assault exercise I.—Two men face each other at about ten yards, equipped for the assault. On the word "charge" from the instructor, both advance at the walk, pieces at the trail. A, when within reach, attacks, doing his best to hit his opponent. B endeavors to parry and return. This should be practiced in each line of attack, given out in advance by the instructor, B taking care, at the start, to show sufficient opening to the attack. Each man knows exactly what his opponent is going to do, and there must be no attempt to deceive the other. The attack must be made only in the line indicated, with speed and determination, and both men must do their best to hit. The man who makes an unsuccessful attack should endeavor to close in on his opponent, to get inside his opponent's bayonet, with a view to tripping and using his butt. The man who makes a successful parry should at once return and try to hit his opponent by any means he has been taught.

728. Assault exercise II.—Two men, equipped for the assault, are placed facing each other at about thirty paces. A is directed to attack, B to defend. On the word "charge" both move forward on a steady double, pieces at the trail. A delivers a determined attack on B. B must parry and *immediately* return. A must understand that this attack must be delivered without hesitation, for it will be impossible to stop and "fence" for an opening. The above is then reversed, B attacks, A defends. This exercise should continue, the instructor giving each man the same opportunity to attack and parry in a given line. In the assault exercises, when a man is hit, he should sing out "hit."

PHYSICAL DRILL WITH ARMS.

NOTE.—From the Manual of Physical Drill by Chaplain W. O. Holway, U. S. N. From Ship and Gun Drills, 1905.

729. General rules.—(1) All movements in this section are 4-counts, and, except "Coming to ready," are performed two (or four) times.

(2) The exercises may be executed by command, or to music, or silently following the motions of a leader, and may be discontinued by the command **HALT**, when the *Order* will be resumed.

(3) Take intervals or distance as prescribed in the drill regulations.

730. Coming to ready.—Commands: *Come to ready*—1, 2, 3. (Plate 26.)

1. Raise the piece with the right hand, grasp it with the left at the height of the right shoulder, knuckles towards the body. The right hand will grasp the small of the stock, forefinger under the guard.

2. Let the piece drop in front of the body to a horizontal, slings down, keeping the body erect.

3. Raise the piece horizontally to the height of the shoulders, slings up, at the same time moving the left foot to the left about twelve inches. Keep the chest out, and the shoulders well back. This position is *Ready*, and is the starting point of all the movements under the arms.

731. 1st Exercise—Down and forward.—SPECIAL ACTION.—The muscles of the hips, back and arms. Commands: *Down and Forward*—1, 2, 3, 4; 1, 2, 3, 4, etc. (Plate 27.)



Fig. 1.
"Coming to Ready,"
First Position.



Plate 26.
Fig. 2.
"Coming to Ready,"
Second Position.



Fig. 3.
"Ready."

1. From *Ready*, lower the piece horizontally to the insteps, keeping arms and knees (if possible) straight.

2. Back to *Ready*, chest out, elbows back.

3. Push piece horizontally forward.

4. Back to *Ready*.

732. 2d Exercise—Forward and up.—SPECIAL ACTION.—The muscles of the arms, and of side walls of the chest.

Commands: *Forward and Up*.—1, 2, 3, 4; 1, 2, 3, 4. (Plate 28.)

1. From *Ready*, push out horizontally forward, as in the last exercise.

2. Back to *Ready*, chest out, elbows back.

3. Push the piece to high vertical, keeping it horizontal, and expanding chest.

4. Back to *Ready*.

733. 3d Exercise—Up and shoulders.—**SPECIAL ACTION.**—The muscles of the arms, and of the side and front walls of the chest.



Fig. 1.
“Down and Forward,” End of
First Count.



Fig. 2.
“Down and Forward,” End of
Third Count.



Plate 28.
“Forward and Up,” Third Count.



Plate 29.
“Up and Shoulders,” Second
Count.

Commands: *Up and Shoulders*—1, 2, 3, 4; 1, 2, 3, 4. (Plate 29.)

1. From *Ready*, push the piece to vertical, as in last exercise.
2. Lower piece to back of shoulders, head up, elbows well back.
3. Up again to vertical.
4. Down to *Ready*.

734. 4th Exercise—*Side pushes*.—SPECIAL ACTION.—The rotary muscles of the body and thighs; the loin muscles.

Commands: *Side Pushes*—1, 2, 3, 4; 1, 2, 3, 4. (Plate 30.)

1. From *Ready*, push the piece horizontally to right side, twisting the body, keeping the eyes on the piece, but keeping the heels firmly on deck.

2. Back to *Ready*, chest out, elbows back.
3. Push the piece to the left side.
4. Back to *Ready*.

735. 5th Exercise—*Diagonal lunges*.—SPECIAL ACTION.—The muscles of the arms, back and legs.

Commands: *Diagonal Lunges*—1, 2, 3, 4; 1, 2, 3, 4. (Plate 31.)

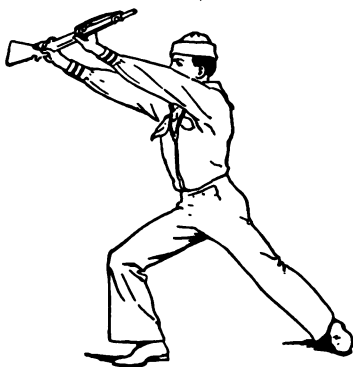


Plate 30.
"Side Pushes," Third Count.

Plate 31.
"Diagonal Lunges," First Count.

1. From *Ready*, lunge diagonally to the right, about thirty-six inches, with the right leg, at the same time bringing the piece up horizontally to 45 degrees. The left foot should be flat, and the eyes directed to the piece.

2. Back to *Ready*, chest out, elbows back.
3. Lunge to the left with left leg, as above.
4. Back to *Ready*.

736. 6th Exercise—Forward lunges.—SPECIAL ACTION.—The muscles of the arms and legs and the side walls of the chest.

Commands: *Forward Lunges*—1, 2, 3, 4; 1, 2, 3, 4. (Plate 32.)

1. From *Ready*, lunge directly to the front, about thirty-six inches, with right leg, at the same time raising piece horizontally to vertical, and directing the eyes to the piece. Keep left foot flat.

2. Back to *Ready*.

3. Lunge to the front with left leg, as above.

4. Back to *Ready*.

737. 7th Exercise—Front sweeps.—SPECIAL ACTION.—All the principal posterior muscles of the body.



Plate 32.
"Forward Lunges," Third Count.



Plate 33.
"Front Sweeps."

Commands: *Front Sweeps, Slow*—1, 2, 3, 4; 1, 2, 3, 4. (Plate 33.)

1. From *Ready*, raise the piece horizontally to high vertical, keeping the chest well out, and emphasizing the up-stretch.

2. Lower the piece slowly in front semi-circle to insteps, keeping the arms straight and emphasizing the out-reach.

3. Raise the piece slowly in front semi-circle to vertical.

4. Down to *Ready*.

738. 8th Exercise—Overhead twists.—SPECIAL ACTION.—The rotary muscles of the upper part of the body; also stimulates the venous circulation.

Commands: *Overhead Twists, Butt Forward.*—1, 2, 3, 4; *Muzzle Forward*—1, 2, 3, 4. (Plate 34.)



Fig. 1.
“Overhead Twists,”
Butt Forward.



Plate 34.

Fig. 2.
“Overhead Twists,” Muzzle Forward.
(Side view.)

1. From *Ready*, raise the piece overhead, at the same time twisting it till the butt points directly forward. Keep the piece horizontal.

2. Twist the piece to the right until the muzzle points directly forward. Hold the hips firmly forward, confining the movement to the upper part of the body.

3. Twist back till the butt points directly forward.

4. Lower the piece to *Ready*.

1. From *Ready*, raise the piece overhead, at the same time twisting it till the muzzle points directly forward.

2. Twist the piece to the left until the butt points directly forward.

3. Twist back until the muzzle points forward.

4. Lower the piece to *Ready*.

739. 9th Exercise—Side twists.—**SPECIAL ACTION.**—The muscles of the sides, loins and small of the back.

(1) Commands: *Side Twists*—1, 2, 3, 4; 1, 2, 3, 4. (Plate 35.)

1. From *Ready*, drop the piece horizontally in front to position No. 2 in *Coming to Ready*.

2. Lifting the butt up, carry the piece strongly to the left side and out, muzzle pointing directly down. Keep the hips firm.

3. Return the piece to position No. 2 in *Coming to Ready*.

4. Lifting the muzzle, carry the piece strongly to the right side and out, muzzle pointing directly up.

(2) Repeat the exercise.

(3) At the end of the 9th Exercise, come to *Order Arms*.



Fig. 1.
"Side Twists," Second Count.



Fig. 2.
"Side Twists," Fourth Count.

Plate 35.

PHYSICAL DRILL WITHOUT ARMS.

(Swedish System.)

NOTE.—From Department of Physical Training, U. S. Naval Academy.

Explanatory.—Lessons A, B, C, are elementary exercises and are used for midshipmen upon entering the Naval Academy and for recruits at the Training Stations. Lessons I to VIII inclusive are exercises used in the training of midshipmen at the Naval Academy and for general use throughout the service.

For each exercise the Starting Position and Exercise are printed in plain type, and the commands in *italics*.

Where dumb-bells are not available, the exercises given for dumb-bells will be given as free standing movements.

740. Elementary exercises.—

LESSON A.

STARTING POSITION.

EXERCISE.

- 1 Standing. Feet closing and full opening.
Feet—Close! Feet full—Open!
- 2 Standing. Wing standing position.
Hips—Firm! Arms downward—Stretch!
- 3 Standing. Foot placing outward.
Left (r) foot outward—Place! Feet together—Place!
- 4 Standing. Arm bending.
Arms—Bend! Arms downward—Stretch!
- 5 Standing. Foot (feet) placing sideways.
Left (r) foot (feet) sideways—Place! Feet together—Place!
- 6 Standing. Rest standing position.
Neck—Rest! Arms downward—Stretch!
- 7 Standing. Foot placing forward.
Left (r) foot forward—Place! Feet together—Place!
- 8 Standing. Arm raising sideways.
Arms sideways—Raise! Arms downward—Sink!
- 9 Standing. Arm bending forward.
Arms forward—Bend! Arm downward—Stretch!
- 10 Outward walk standing. Feet changing.
*Left (r) foot outward—Place!
Feet change—Place! Feet together—Place!*
- 11 Yard standing. Hand turning.
*Arms sideways—Raise!
Hands upward—Turn! Hands downward—Turn!
Arms downward—Sink!*
- 12 Standing. Lunging outward.
Left (r) foot outward—Lunge! Feet together—Place!

STARTING POSITION.

EXERCISE.

- 13 Standing. Arm raising sideways and upwards.
Arms sideways and upward—Raise!
Arms sideways and downward—Sink!
- 14 Standing. Lunging forward.
Left (r) foot forward—Lunge! Feet together—Place!
- 15 Standing. Arm raising forward and upward.
Arms forward and upward—Raise!
Arms forward and downward—Sink!
- 16 Standing. Arm raising forward.
Arms forward—Raise! Arms downward—Sink!

LESSON B.

- 17 Wing standing. Heel raising.
Hips—Firm!
Heels—Raise! Heels—Sink! Arms downward—Stretch!
- 18 Standing. Hand turning outward.
Hands outward—Turn! Hands inward—Turn!
- 19 Standing. Arm stretching sideways.
Arms sideways—Stretch! Arms downward—Stretch!
- 20 Standing. Head bending backward (forward).
Head backward (forward)—Bend! Head upward—Stretch!
- 21 Wing close standing. Heel raising.
Feet closing and hips—Firm!
Heels—Raise! Heels—Sink!
Feet open and arms downward—Stretch!
- 22 Standing. Arm stretching upward.
Arms upward—Stretch! Arms downward—Stretch!
- 23 Standing. Head twisting.
Head to the left (r)—Twist! Head forward—Twist!
- 24 Wing standing. Trunk bending backward.
Hips—Firm!
Trunk backward—Bend! Trunk upward—Stretch!
Arms downward—Stretch!
- 25 Wing stride standing. Heel raising.
Left (r) foot sideways and hips—Firm!
Heels—Raise! Heels—Sink!
Feet together and arms downward—Stretch!
- 26 Standing. Arms stretching forward.
Arms forward—Stretch! Arms downward—Stretch!
- 27 Standing. Head bending sideways.
Head to the left (r)—Bend! Head upward—Stretch!

STARTING POSITION.

EXERCISE.

- 28 Stretch standing. Trunk bending backward.
Arms upward—Stretch!
Trunk backward—Bend! Trunk upward—Stretch!
Arms downward—Stretch!
- 29 Wing outward walk standing. Heel raising.
Left (r) foot outward and hips—Firm!
Heels—Raise! Heels—Sink!
Feet together and arms downward—Stretch!
- 30 Standing. Arm stretching backward.
Arms backward—Stretch! Arms downward—Stretch!
- 31 Yard (reach) (stretch) (drag) Arm stretching downward.
Arms sideways (forward) (upward) (backward)—Stretch!
Arms downward—Stretch!
- 32 Wing forward walk standing. Heel raising.
Left (r) foot forward and hips—Firm!
Heels—Raise! Heels—Sink!
Feet together and arms downward—Stretch!
- 33 Yard standing. Arm striking.
Arms sideways—Stretch!
Arms forward—Bend! Arms sideways—Strike!
Arms downward—Stretch!

LESSON C.

- 34 Wing standing. Heel raising and knee bending.
Hips—Firm!
Heels—Raise! Knees—Bend! Knees—Stretch!
Heels—Sink!
Arms downward—Stretch!
- 35 Bend standing. Arm half stretch upward and downward.
Arms—Bend!
Right (l) arm upward and left (r) arm downward—Stretch!
Arms—Bend! Arms downward—Stretch!
- 36 Standing. Head twisting and bending backward.
Head to the left (r)—Twist! Head backward—Bend!
Head upward—Stretch! Head forward—Twist!
- 37 Wing standing. Trunk bending backward.
Hips—Firm! Trunk backward—Bend!
Trunk upward—Stretch!
Arms downward—Stretch!
- 38 Rest standing. Heel raising and knee bending to sitting.
Neck—Rest! Heels—Raise!
Knees to sitting—Bend! Knees—Stretch!
Heels—Sink! Arms downward—Stretch!

STARTING POSITION.

EXERCISE.

- 39 Half stretch standing. Arm changing.
Left (r) arm upward right (l) arm downward—Stretch!
Arms change—Stretch! Arms downward—Stretch!
- 40 Wing stoop standing. Trunk bending downward.
Hips—Firm! Trunk forward—Bend!
Trunk downward—Bend! Trunk forward—Stretch!
Trunk upward—Stretch! Arms downward—Stretch!
- 41 Half stretch half reach standing. Arm changing.
Left (r) arm upward, right (l) arm forward—Stretch!
Arms change—Stretch!
Arms downward—Stretch!
- 42 Bend stride standing. Heel raising and knee bending.
Left (r) foot sideways placing and arms—Bend!
Heels—Raise! Knees—Bend!
Knees—Stretch! Heels—Sink!
Feet together and arms downward—Stretch!
- 43 Close standing. Side bending.
Feet—Close! Trunk to the left (r)—Bend!
Trunk upward—Stretch! Feet—Open!
- 44 Half yard half reach standing. Arm changing.
Right (l) arm sideways and left (r) arm forward—Stretch!
Arms change—Stretch!
Arms downward—Stretch!
- 45 Rest stride standing. Heel raising and knee bending.
Left (r) foot sideways and neck—Rest!
Heels—Raise! Knees—Bend!
Knees—Stretch! Heels—Sink!
Feet together and arms downward—Stretch!
- 46 Wing close standing. Trunk twisting.
Feet closing and hips—Firm!
Trunk to the left (r)—Twist!
Feet open and arms downward—Stretch!
- 47 Standing. Foot placing sideways with arm bending.
Left (r) foot sideways placing and arms—Bend!
Feet together and arms downward—Stretch!
- 48 Standing. Foot placing outward with arm stretching upward.
Left (r) foot outward placing and arms upward—Stretch!
Feet together and arms downward—Stretch!

741. General Service Exercises.—

FREE STANDING LESSON No. I.

STARTING POSITION.

EXERCISE.

- 49 Standing. Feet closing and hips firm.
Feet closing and hips—Firm!
Feet open and arms downward—Stretch!
- 50 Standing. Heel raising and hips firm.
Heel raising and hips—Firm!
Heel sinking and arms downward—Stretch!
- 51 Standing. Head bending backward with hand turning outward.
Head backward bending and hands outward—Turn!
Head upward stretching and hands inward—Turn!
- 52 Close standing. Side bending.
Feet—Close!
Trunk to the left (r)—Bend! Trunk upward—Stretch!
Feet—Open!
- 53 Wing standing. Heel raising and knee bending.
Hips—Firm!
Heels—Raise! Knees—Bend!
Knees—Stretch! Heels—Sink!
Arms downward—Stretch!
- 54 Standing. Trunk bending backward with hands turning outward.
Trunk backward bending and hands outward—Turn!
Trunk upward stretching and hands inward—Turn!
- 55 Stretch stride arch standing. Arm stretching upward.
Feet sideways and arms upward—Stretch!
Trunk backward—Bend!
Arms—Bend! Arms upward—Stretch!
Trunk upward—Stretch!
Feet together and arms downward—Stretch!
- 56 Standing. Arm stretching upward, forward, sideways and downward.
Arms upward—Stretch! Arms forward—Stretch!
Arms sideways—Stretch! Arms downward—Stretch!
- 57 Wing standing. Alternate knee upbending.
Hips—Firm!
Left (r) knee upward—Bend! Feet together—Place!
Arms downward—Stretch!
- 58 Reach standing. Arm swinging upward and forward.
Arms forward—Stretch!
Arm upward—Swing! Arm forward—Swing!
Arm downward—Stretch!

STARTING POSITION.

EXERCISE.

- 59 Stoop falling. Head twisting.
Stoop falling—Place!
Head to the left (r)—Twist! Head forward—Twist!
Attention!
- 60 Wing stride kneeling. Trunk falling backward.
Stride kneeling—Place! Hips—Firm!
Trunk backward—Fall! Trunk upward—Stretch!
Arms downward—Stretch!
Attention!
- 61 Wing stride standing. Trunk twisting.
Left (r) foot sideways and hips—Firm!
Trunk to the left (r)—Twist! Trunk forward—Twist!
Feet together and arms downward—Stretch!

DUMB-BELL LESSON No. I.

- 62 Standing. Arm raising sideways.
Arms sideways—Raise! Arms downward—Sink!
- 63 Standing. Heel raising with arm raising sideways and upward.
Heel raising and arms sideways and upward—Raise!
Heel sinking and arms sideways and downward—Sink!
- 64 Bend standing. Heel raising and knee bending with arm stretching upward.
Arms—Bend!
Heels—Raise! Knees bending and arms upward—Stretch!
Knees—Stretch! Heels sinking and arms—Bend! Arms downward—Stretch!
- 65 Bend standing. Alternate leg raising sideways with arm stretching forward.
Arms—Bend!
Left (r) leg sideways raising and arms forward—Stretch!
Feet together and arms—Bend! Arms downward—Stretch!
- 66 Bend standing. Arm stretching forward, upward, sideways and backward.
Arms—Bend!
Arms forward—Stretch! Arms—Bend!
Arms upward—Stretch! Arms—Bend!
Arms sideways—Stretch! Arms—Bend!
Arms backward—Stretch! Arms—Bend!
Arms downward—Stretch!
- 67 Standing. Alternate leg raising backward with arm raising forward.
Left (r) leg backward raising and arms forward—Raise!
Feet together and arms downward—Sink!

STARTING POSITION.

EXERCISE.

- 68 Forward bend standing. Arm striking.
Arms forward—Bend!
Arms sideways—Strike! Arms forward—Bend!
Arms downward—Stretch!

FREE STANDING LESSON No. II.

- 69 Standing. Alternate foot placing with neck rest.
Left (r) foot outward (forward) and neck—Rest!
Feet together and arms downward—Stretch!
- 70 Wing outward walk standing. Heel raising.
Left (r) foot outward and hips—Firm!
Heels—Raise! Heels—Sink!
Feet together and arms downward—Stretch!
- 71 Stride standing. Head twisting with arm raising sideways.
Feet sideways—Place!
Head to the left (r) twisting and arms sideways—Raise!
Head forward twisting and arms downward—Sink.
Feet together—Place!
- 72 Rest forward walk standing. Trunk twisting.
Left (r) foot forward and neck—Rest!
Trunk to the left (r)—Twist! Trunk forward—Twist!
Feet together and arms downward—Stretch!

NOTE.—Trunk twisting in the "walk" position is only executed to the side of the advanced foot. Then feet changing is done and the exercise repeated to the other side.

- 73 Wing standing. Alternate foot placing outward with heel raising.
Hips—Firm!
Left (r) foot outward—Place! Heels—Raise!
Heels—Sink! Feet together—Place!
Arms downward—Stretch!
- 74 Bend forward walk standing. Trunk bending backward with arm stretching upward.
Left (r) foot forward and arms—Bend!
Trunk backward bending and arms upward—Stretch!
Trunk upward stretching and arms—Bend!
Feet together and arms downward—Stretch!
- 75 Standing. Arm stretching (half stretching), various directions.

NOTE.—The exercise is carried out as in arm stretching and half stretching.

- 76 Rest crook standing. Foot bending and stretching.
Left (r) knee upbending and neck—Rest!
Foot upward—Bend! Foot downward—Stretch!
Feet together and arms downward—Stretch!

STARTING POSITION.

EXERCISE.

- 77 Bend stride standing. Trunk bending forward.
Left (r) foot sideways and arms—Bend!
Trunk forward—Bend! Trunk upward—Stretch!
Feet together and arms downward—Stretch!
- 78 Yard forward lunge standing. Arm stretching sideways.
Left (r) foot forward lunging and arms sideways—Stretch!
Arms—Bend! Arms sideways—Stretch!
Feet together and arms downward—Stretch!
- 79 Wing fall stride kneeling. Change to neck rest.
Stride kneeling—Place! Hips—Firm!
Trunk backward—Fall! Neck—Rest! Hips—Firm!
Trunk upward—Stretch! Arms downward—Stretch!
Attention!
- 80 Stoop falling. Feet placing forward and backward.
Stoop falling—Place!
Feet forward—Place! Feet backward—Place!
Attention!
- 81 Yard stride standing. Side bending.
Feet sideways and arms sideways—Stretch!
Trunk to the left (r)—Bend! Trunk upward—Stretch!
Feet together and arms downward—Stretch!

DUMB-BELL LESSON No. II.

- 82 Standing. Arm circling.
Arms forward and upward—Raise!
Arms sideways and downward—Sink!
- 83 Standing. Heel raising and knee bending with arm stretching upward.
Heel raising and arms—Bend!
Knee bending and arms upward—Stretch!
Knee stretching and arms—Bend!
Heel sinking and arms downward—Stretch!
- 84 Bend outward walk standing. Feet changing with arm stretching sideways.
Left (r) foot outward and arms—Bend!
With arms stretching sideways, feet change—Place!
Feet together and arms downward—Stretch!
- 85 Bend standing. Alternate knee upbending with arm stretching backward.
Arms—Bend!
Left (r) knee upbending and arms backward—Stretch!
Feet together and arms—Bend!
Arms downward—Stretch!

STARTING POSITION.

EXERCISE.

- 86 Toe standing. Arm stretching upward, sideways and downward.

Heels—Raise! Arms upward—Stretch!

Arms sideways—Stretch! Arms downward—Stretch!

Heels—Sink!

- 87 Bend standing. Alternate leg raising backward with arm stretching forward.

Arms—Bend!

Left (r) leg backward raising and arms forward—Stretch!

Feet together and arms—Bend!

Arms downward—Stretch!

- 88 Reach standing. Arm swinging sideways.

Arms forward—Stretch!

Arms sideways—Swing! Arms forward—Swing!

FREE STANDING LESSON No. III.

- 89 Standing. Alternate foot placing forward with arm bending forward.

Left (r) foot forward and arms forward—Bend!

Feet together and arms downward—Stretch!

- 90 Wing standing. Alternate foot placing sideways and heel raising.

Hips—Firm!

Left (r) foot sideways—Place! Heels—Raise!

Heels—Sink! Feet together—Place!

Arms downward—Stretch!

- 91 Standing. Lunging outward with arm raising sideways.

Left (r) foot outward lunging and arms sideways—Raise!

Feet together and arms downward—Sink!

- 92 Half stretch standing. Side bending.

Left (r) arm upward right (l) arm downward—Stretch!

Trunk to the left (r)—Bend! Trunk upward—Stretch!

Arms downward—Stretch!

NOTE.—When side bending is carried out in the half stretch position, the bending always takes place to the side of the downward stretched arm. Before the exercise is repeated to the other side arm changing is executed.

- 93 Wing spring standing. Head twisting quickly.

Heels—Raise! Knee bending and hips—Firm!

Head to the left (r)—Twist! Head forward—Twist!

Knees—Stretch! Heel sinking and arms downward—Stretch!

- 94 Stretch standing. Trunk bending backward.

Arms upward—Stretch!

Trunk backward—Bend! Trunk upward—Stretch!

Arms downward—Stretch!

STARTING POSITION.

EXERCISE.

- 95 Standing. Arms stretching various directions.

NOTE.—The exercise is carried out as in Paragraph 66.

- 96 Yard standing. Alternate leg raising sideways.

Arms sideways—Stretch!

Left (r) leg sideways—Raise! Feet together—Place!

Arms downward—Stretch!

- 97 Forward lying. Trunk bending backward with hand turning outward.

Forward lying—Place!

Trunk backward bending and hands outward—Turn!

Trunk upward stretching and hands inward—Turn!

Attention!

- 98 Reach forward lunge standing. Arm swinging upward and forward.

Left (r) foot forward lunging and arms forward—Stretch!

Arms upward—Swing! Arms forward—Swing!

Feet together and arms downward—Stretch!

- 99 Forward bend fall stride kneeling. Arm striking.

Stride kneeling—Place! Arms forward—Bend!

Trunk backward—Fall!

Arms sideways—Strike! Arms forward—Bend!

Trunk upward—Stretch! Arms downward—Stretch!

Attention!

- 100 Stride stoop falling. Head twisting with arm bending.

Stoop falling—Place! Feet sideways—Place!

Head to the left (r) twisting and arms—Bend!

Head forward twisting and arms—Stretch!

Feet together—Place! Attention!

- 101 Wing lying. Leg raising forward (clear of deck).

Stoop falling—Place! Change to lying on left (r) arm—Turn!

Hips—Firm! Heels clear of deck—Raise!

Legs forward—Raise! Legs downward—Sink!

Heels to the deck—Sink! Arms downward—Stretch!

Change to stoop falling on left (r) arm—Turn! Attention!

- 102 Yard outward lunge standing. Side bending.

Left (r) foot outward lunging and arms sideways—Stretch!

Trunk to the left (r)—Bend! Trunk upward—Stretch!

Feet together and arms downward—Stretch!

NOTE.—The side bending is carried out as in Paragraph 92.

DUMB-BELL LESSON No. III.

STARTING POSITION.

EXERCISE.

- 103 Standing. Alternate foot placing forward with arm raising forward.
Left (r) foot forward and arms forward—Raise!
Feet together and arms downward—Sink!
- 104 Standing. Arm swinging forward and upward and sideways and downward.
Arms forward and upward—Swing!
Arms sideways and downward—Swing!
- 105 Standing. Alternate leg raising sideways with arm swinging sideways and upward.
Left (r) leg sideways raising and arms sideways and upward—Swing!
Feet together and arms sideways and downward—Swing!
- 106 Bend spring standing. Arm stretching sideways, upward and backward.
Heels—Raise! Knee bending and arms—Bend!
- NOTE.—The arm stretching is carried out as in Paragraph 66.
Knees—Stretch! Heels sinking and arms downward—Stretch!
- 107 Half stretch standing. Side bending.
Left (r) arm upward, right (l) arm downward—Stretch!
- NOTE.—The side bending is carried out as in Paragraph 92.
Arms downward—Stretch!
- 108 Reach standing. Trunk bending backward with arm swinging sideways.
Arms forward—Stretch!
Trunk backward bending and arms sideways—Swing!
Trunk upward stretching and arms forward—Swing!
Arms downward—Stretch!

FREE STANDING LESSON No. IV.

- 109 Rest outward walk standing. Feet changing.
Left (r) foot outward and neck—Rest!
Feet change—Place!
Feet together and arms downward—Stretch!
- 110 Stretch standing. Alternate foot placing outward and heel raising.
Arms upward—Stretch!
Left (r) foot outward—Place! Heels—Raise!
Heels—Sink! Feet together—Place!
Arms downward—Stretch!

STARTING POSITION.

EXERCISE.

- 111 Bend standing. Alternate lunging forward with arm stretching upward.

Arms—Bend!

Left (r) foot forward lunging and arms upward—Stretch!

Feet together and arms—Bend!

Arms downward—Stretch!

- 112 Wing outward walk standing. Heel raising and knee bending.

Left (r) foot outward and hips—Firm!

Heels—Raise! Knees—Bend!

Knees—Stretch! Heels—Sink!

Feet together and arms downward—Stretch!

- 113 Stretch stride standing. Trunk bending backward.

Feet sideways and arms upward—Stretch!

Trunk backward—Bend! Trunk upward—Stretch!

Feet together and arms downward—Stretch!

- 114 Spring standing. Arm stretching various directions.

Heels—Raise! Knees—Bend!

NOTE.—The arm stretching is carried out as in Paragraph 66.

Knees—Stretch! Heels—Sink!

- 115 Wing crook standing. Knee stretching backward.

Left (r) knee upbending and hips—Firm!

Knee backward—Stretch! Knee upward—Bend!

Feet together and arms downward—Stretch!

- 116 Bend arch forward lying. Arm stretching sideways.

Forward lying—Place! Arms—Bend!

Trunk backward—Bend!

Arms sideways—Stretch! Arms—Bend!

Trunk upward—Stretch! Arms downward—Stretch!

Attention!

- 117 Bend horizontal toe support. Arm stretching sideways standing.

Left (r) foot horizontal toe support and arms—Bend!

Arms sideways—Stretch! Arms—Bend!

Feet together and arms downward—Stretch!

- 118 Yard (b) fall stride kneeling. Arm parting.

Stride kneeling—Place! Arms sideways—Raise!

Hands upward—Turn! Trunk backward—Fall!

Arms upward—Raise! Arms sideways—Sink!

Trunk upward—Stretch! Hands downward—Turn!

Arms downward—Sink! Attention!

- 119 Stoop falling. Change to back stoop falling.

Stoop falling—Place!

Change to back stoop falling on left (r) arm—Turn!

Change to stoop falling—Place! Attention!

STARTING POSITION.

EXERCISE.

126 Standing.

Arm stretching (half stretching),
various directions.

NOTE.—The arm stretchings (half stretching) are carried out as in Paragraph 66.

FREE STANDING LESSON No. V.

127 Wing standing.

Heel raising.

*Hips—Firm!**Heels—Raise! Heels—Sink!**Arms downward—Stretch!*

128 Rest standing.

Alternate foot placing forward.

*Neck—Rest!**Left (r) foot forward—Place! Feet together—Place!**Arms downward—Stretch!*

129 Wing standing.

Lunging forward (outward).

*Hips—Firm!**Left (r) foot forward (outward)—Lunge!**Feet together—Place!**Arms downward—Stretch!*

130 Standing.

Alternate foot placing outward and heel
raising and knee bending.*Left (r) foot outward—Place! Heels—Raise!**Knees—Bend! Knees—Stretch!**Heels—Sink! Feet together—Place!*131 Stretch outward walk standing. Feet changing with arm
stretching upward.*Left (r) foot outward and arms upward—Stretch!**With arms stretching upward feet change—Place!**Feet together and arms downward—Stretch!*

132 Standing.

Alternate foot placing sideways with arm
bending, heel raising with arm stretching
upward, alternate knee bending with
arm parting.*Left (r) foot sideways and arms—Bend!**Heels raising and arms upward—Stretch!**Knees bending and arms sideways—Sink!**Knee stretching and arms upward—Raise!**Heels sinking and arms—Bend!**Feet together and arms downward—Stretch!*

133 Stretch forward walk arch standing.

Feet changing with
arm stretching upward.*Left (r) foot forward and arms upward—Stretch!**Trunk backward—Bend!**With arms stretching upward feet change—Place!**Trunk upward—Stretch!**Feet together and arms downward—Stretch!*

STARTING POSITION.

EXERCISE.

- 134 Bend spring sitting. Arm stretching various directions.
Heels—Raise! Knees to sitting and arms—Bend!

NOTE.—The arm stretchings are carried out as in Paragraph 66.

Knees—Stretch! Heel sinking and arms downward—Stretch!

- 135 Stretch crook standing. Knee stretching forward.
Left (r) knee upbending and arms upward—Stretch!
Knee forward—Stretch! Knee—Bend!
Feet together and arms downward—Stretch!

- 136 Stretch twist outward lunge standing. Arm swinging
 backward and upward.
Class half left (r)—Face! Left (r) foot back outward lung-
ing and arms upward—Stretch!

Trunk to the left (r)—Twist!

Arms forward and backward—Swing!

Arms forward and upward—Swing!

Trunk forward—Twist!

NOTE.—Feet changing is executed and the exercise is carried out as above.

Feet together and arms downward—Stretch!

NOTE.—Then the class is again faced to the front.

- 137 Stride stoop falling. Alternate leg raising backward.
Stoop falling—Place! Feet sideways—Place!
Left (r) leg backward—Raise!
Left (r) leg downward—Sink!
Feet together—Place! Attention!

- 138 Crouch standing. Alternate leg stretching sideways
 (with a jump).

Crouch standing—Place!

Left (r) leg sideways—Stretch! Feet together—Place!

NOTE.—Leg stretching sideways with a jump is executed by numbers. At
 "one," the leg that is stretched sideways is carried back to the other leg, and
 at the same time the other leg is stretched sideways and so on.

Attention!

- 139 Stretch lying. Legs raising forward (clear of deck).
Stoop falling—Place!
Change to lying on left (r) arm—Turn!
Arms upward—Stretch! Heels clear of deck—Raise!
Legs forward—Raise! Legs downward—Sink!
Heels to the deck—Sink! Arms downward—Stretch!
Change to stoop falling on left (r) arm—Turn! Attention!

- 140 Stretch stride standing. Side bending.
Feet sideways and arms upward—Stretch!
Trunk to the left (r)—Bend! Trunk upward—Stretch!
Feet together and arms downward—Stretch!

DUMB-BELL LESSON No. V.

STARTING POSITION.

EXERCISE.

- 141 Bend spring sitting. Arm stretching various directions.
Heels—Raise! Knees to sitting and arms—Bend!

NOTE.—The arm stretchings are carried out as in Paragraph 66.

Knees—Stretch!

Heels sinking and arms downward—Stretch!

- 142 Yard (b) standing. Arms parting.
Arms sideways—Stretch! Hands upward—Turn!
Arms upward—Raise! Arms sideways—Sink!
Hands downward—Turn! Arms downward—Stretch!

- 143 Standing. Leg raising forward with arm raising forward,
 lunging forward with arm swinging sideways.
Left (r) leg forward raising and arms forward—Raise!
Left (r) leg forward lunging and arms sideways—Swing!
Left (r) leg forward raising and arms forward—Swing!
Feet together and arms downward—Sink!

- 144 Standing. Heels raising and knees bending with arms
 swinging forward and upward, knee stretch-
 ing and heel sinking with arms swinging
 sideways and downward.

Heels—Raise!

Knee bending and arms forward and upward—Swing!

Knees—Stretch!

Heels sinking and arms sideways and downward—Swing!

- 145 Yard standing. Alternate leg raising sideways with arm
 striking.

Arms sideways—Stretch!

Left (r) leg sideways raising and arms forward—Bend!

Feet together and arms sideways—Strike!

Arms downward—Stretch!

- 146 Bend arch standing. Feet placing sideways with a jump.
Arms—Bend! Trunk backward—Bend!
Feet sideways with a jump and arms sideways—Stretch!
Feet together and arms—Bend!
Trunk upward—Stretch! Arms downward—Stretch!

FREE STANDING LESSON No. VI.

- 147 Standing. Head bending backward with arm raising
 sideways.

Head backward bending and arms sideways—Raise!

Head upward stretching and arms downward—Sink!

STARTING POSITION.

EXERCISE.

- 148 Wing standing. Heel raising and knee bending to sitting.
Hips—Firm!
Heels—Raise! Knees to sitting—Bend!
Knees—Stretch! Heels—Sink!
Arms downward—Stretch!
- 149 Bend standing. Trunk bending backward with arm stretching backward.
Arms—Bend!
Trunk backward bending and arms backward—Stretch!
Trunk upward stretching and arms—Bend!
Arms downward—Stretch!
- 150 Bend spring sitting. Arm stretching upward and sideways.
Heels—Raise! Knees to sitting and arms—Bend!
Arms upward—Stretch! Arms—Bend!
Arms sideways—Stretch! Arms—Bend!
Knees—Stretch!
Heel sinking and arms downward—Stretch!
- 151 Bend crook standing. Knee stretching forward and backward with arm stretching forward and sideways.
Left (r) knee upbending and arms—Bend!
Knee forward stretching and arms forward—Stretch!
Knee bending and arms—Bend!
Knee backward stretching and arms sideways—Stretch!
Knee upbending and arms—Bend!
Feet together and arms downward—Stretch!
- 152 Yard arch forward lying. Arm striking.
Forward lying—Place! Arms sideways—Stretch!
Trunk backward—Bend!
Arms forward—Bend! Arms sideways—Strike!
Trunk upward—Stretch! Arms downward—Stretch!
Attention!
- 153 Fall stride kneeling. Arms swinging forward and upward.
Stride kneeling—Place! Trunk backward—Fall!
Arms forward and upward—Swing!
Arms forward and downward—Swing!
Trunk upward—Stretch! Attention!
- 154 Bend side falling. Leg raising sideways.
Stoop falling—Place!
Change to side falling on left (r) arm and arm—Bend!
Leg sideways—Raise! Feet together—Place!
Change to stoop falling—Place! Attention!

DUMB-BELL LESSON No. VI.

STARTING POSITION.

EXERCISE.

- 155 Wing stride for toe standing. Alternate knee bending.
Left (r) foot sideways—Place!
Heel raising and hips—Firm!
Left (r) knee—Bend! Knee—Stretch!
Heels—Sink! Feet together and arms downward—Stretch!
- 156 Stretch standing. Heel raising with arm swinging backward and upward.
Arms upward—Stretch!
Heel raising and arms forward and backward—Swing!
Heel sinking and arms forward and upward—Swing!
Arms downward—Stretch!
- 157 Stretch spring sitting. Arm swinging sideways and downward and forward and upward.
Heel raising and arms—Bend!
Knees to sitting and arms upward—Stretch!
Arms sideways and downward—Swing!
Arms forward and upward—Swing!
Knees stretching and arms—Bend!
Heels sinking and arms downward—Stretch!
- 158 Bend standing. Arm stretching (half stretching) various directions.
Arms—Bend!
- NOTE.—The arm stretchings are carried out as in Paragraph 66. The half stretchings are carried out as in Paragraph 92.
Arms downward—Stretch!
- 159 Standing. Alternate knee upbending and stretching forward with arm stretching upward and downward.
Left (r) knee upbending and arms—Bend!
Knee forward stretching and arms upward—Stretch!
Knee bending and arms—Bend!
Feet together and arms downward—Stretch!
- 160 Bend forward lunge standing. Arm stretching in various directions.
Left (r) foot forward lunging and arms—Bend!
- NOTE.—The arm stretching is carried out as in Paragraph 66.
Feet together and arms downward—Stretch!

FREE STANDING LESSON No. VII.

- 161 Standing. Heel raising with arm raising sideways and upward.
Heels raising and arms sideways and upward—Raise!
Heels sinking and arms sideways and downward—Sink!

STARTING POSITION.

EXERCISE.

- 162 Half stretch close standing. Side bending.
Feet closing and left (r) arm upward and right (l) arm downward—Stretch!
Trunk to the left (r)—Bend! Trunk upward—Stretch!
Feet open and arms downward—Stretch!
- 163 Stretch standing. Head bending backward with arm parting.
Arms upward—Stretch!
Head backward bending and arms sideways—Sink!
Head upward stretching and arms upward—Raise!
Arms downward—Stretch!
- 164 Stretch toe standing. Knee bending to sitting.
Heels raising and arms upward—Stretch!
Knees to sitting—Bend!
Knees—Stretch!
Heels sinking and arms downward—Stretch!
- 165 Stretch stride standing. Trunk bending backward with arm parting.
Feet sideways and arms upward—Stretch!
Trunk backward bending and arms sideways—Sink!
Trunk upward stretching and arms upward—Raise!
Feet together and arms downward—Stretch!
- 166 Bend standing. Arm stretching (half stretching) various directions.
Arms—Bend!

NOTE.—The arm stretchings are carried out as in Paragraph 66. The half stretchings are carried out as in Paragraph 92.

- Arms downward—Stretch!*
- 167 Standing. Alternate leg raising backward with arm circling.
Left (r) leg backward raising and arms forward and upward—Raise!
Feet together and arms sideways and downward—Sink!
- 168 Bend arch forward lying. Arm half stretching various directions.
Forward lying—Place! Arms—Bend!
Trunk backward—Bend!

NOTE.—The half stretchings are carried out as in Paragraph 92.

- Trunk upward—Stretch! Arms downward—Stretch!*
Attention!
- 169 Stoop falling. Feet placing sideways with a jump with arm bending.
Stoop falling—Place!
Feet sideways with a jump and arms—Bend!
Feet together and arms—Stretch!
Attention!

STARTING POSITION.

EXERCISE.

170 Bend side falling.

Leg raising sideways with arm stretching upward.

*Stoop falling—Place! Change to side falling on left (r) arm and right (l) arm—Bend!**Leg sideways raising and arm upward—Stretch!**Feet together and arm—Bend!**Change to stoop falling—Place! Attention!*

DUMB-BELL LESSON No. VII.

171 Stretch stride spring standing. Arm parting.

*Left (r) foot sideways—Place!**Heel raising and arms—Bend!**Knee bending and arms upward—Stretch!**Arms sideways—Sink! Arms upward—Raise!**Knees—Stretch! Heels sinking and arms—Bend!**Feet together and arms downward—Stretch!*

172 Bend arch forward walk standing. Arm stretching, various directions.

*Left (r) foot forward and arms—Bend!**Trunk backward—Bend!*

NOTE.—The arm stretchings are carried out as in Paragraph 66.

*Trunk upward—Stretch!**Feet together and arms downward—Stretch!*

173 Stretch forward walk standing. Rear leg half kneeling with arm parting.

*Left (r) foot forward and arms upward—Stretch!**Rear leg kneeling and arms sideways—Sink!**Leg stretching and arms upward—Raise!**Feet together and arms downward—Stretch!*

174 Half stretch half yard standing. Arm changing.

*Left (r) arm upward right (l) arm sideways—Stretch!**Arms change—Stretch!**Arms downward—Stretch!*175 Standing. Alternate leg raising forward with arm circling.
*Left (r) leg forward raising and arms forward and upward—Raise!**Feet together and arms sideways and downward—Sink!*

176 Stretch arch forward lying. Arm parting.

*Forward lying—Place! Arms upward—Stretch!**Trunk backward—Bend!**Arms sideways—Sink! Arms upward—Raise!**Trunk upward—Stretch! Arms downward—Stretch!**Attention!*

FREE STANDING LESSON No. VIII.

STARTING POSITION.

EXERCISE.

- 177 Standing. Head bending backward with arm raising backward.
Head backward bending and arms backward—Raise!
Head upward stretching and arms downward—Sink!
- 178 Stretch standing. Arm parting.
Arms upward—Stretch!
Arms sideways—Sink! Arms upward—Raise!
Arms downward—Stretch!
- 179 Wing standing. Alternate foot placing outward and trunk bending forward.
Hips—Firm!
Left (r) foot outward—Place! Trunk forward—Bend!
Trunk upward—Stretch! Feet together—Place!
Arms downward—Stretch!
- 180 Stretch forward lunge standing. Feet changing with arm swinging backward and upward.
Left (r) foot forward lunging and arms upward—Stretch!
Arm swinging backward and upward feet change—Place!
Feet together and arms downward—Stretch!
- 181 Stretch stride twist standing. Trunk bending backward.
Feet sideways and arms upward—Stretch!
Trunk to the left (r)—Twist!
Trunk backward—Bend! Trunk upward—Stretch!
Trunk forward—Twist!
Feet together and arms downward—Stretch!
- 182 Bend stride standing. Heel raising and knee bending to sitting with arm stretching upward and sideways.
Left (r) foot sideways and arms—Bend!
Heel raising and arms upward—Stretch!
Knees to sitting and arms—Bend!
Knee stretching and arms sideways—Stretch!
Heel sinking and arms—Bend!
Feet together and arms downward—Stretch!
- 183 Arch forward walk standing. Arm stretching upward, backward and downward.
Left (r) foot forward—Place! Trunk backward—Bend!
Arms upward—Stretch! Arms backward—Stretch!
Arms downward—Stretch!
Trunk upward—Stretch Feet together—Place!

STARTING POSITION.

EXERCISE.

- 184 Yard (b) stride toe standing. Alternate knee bending with arm parting.

Feet sideways and arms sideways—Stretch!
Heel raising and hands upward—Turn!
Left (r) knee bending and arms upward—Raise!
Knee stretching and arms sideways—Sink!
Heels sinking and hands downward—Turn!
Feet together and arms downward—Stretch!

- 185 Bend forward lunge standing. Arm stretching various directions.

Left (r) foot forward lunging and arms—Bend!

NOTE.—The arm stretchings are carried out as in Paragraph 66.

Feet together and arms downward—Stretch!

- 186 Back stoop falling. Alternate leg raising forward.

Stoop falling—Place!

Change to back stoop falling on left (r) arm—Turn!

Left (r) leg forward—Raise! Feet together—Place!

Change to stoop falling on left (r) arm—Turn! Attention!

- 187 Stretch outward lunge inward Side bending.
twist standing.

Left (r) foot outward lunging and arms upward—Stretch!

Trunk inward—Twist!

Trunk to the left (r)—Bend! Trunk upward—Stretch!

Trunk forward—Twist!

Feet together and arms downward—Stretch!

DUMB-BELL LESSON No. VIII.

- 188 Stretch standing. Knee upbending and stretching backward with arm stretching upward.

Arms upward—Stretch!

Left (r) knee upbending and arms—Bend!

Knee backward stretching and arms upward—Stretch!

Knee upbending and arms—Bend!

Feet together and arms upward—Stretch!

Arms downward—Stretch!

- 189 Yard spring sitting. Knee stretching with arm sinking.

Heel raising and arms—Bend!

Knees to sitting and arms sideways—Stretch!

Knee stretching and arms downward—Sink!

Knees to sitting and arms sideways—Raise!

Knee stretching and arms—Bend!

Heels sinking and arms downward—Stretch!

STARTING POSITION.

EXERCISE.

- 190 Bend forward walk arch twist standing. Arm stretching upward.

*Left (r) foot forward and arms—Bend!
Trunk to the left (r)—Twist! Trunk backward—Bend!
Arms—Bend! Arms upward—Stretch!
Trunk upward—Stretch! Trunk forward—Twist!
Feet together and arms downward—Stretch!*

- 191 Standing. Alternate leg raising forward with arm circling.
*Left (r) leg forward raising and arms forward and upward—
Raise!
Feet together and arms sideways and downward—Sink!*

- 192 Stretch outward lunge standing. Feet changing with arm stretching upward.
*Left (r) foot outward lunging and arms upward—Stretch!
With arms stretching upward feet change—Place!
Feet together and arms downward—Stretch!*

- 193 Standing. Alternate foot placing forward with arm raising forward, rear leg half kneeling with arm raising upward.
*Left (r) foot forward and arms forward—Raise!
Rear leg kneeling and arms upward—Raise!
Rear leg stretching and arms forward—Sink!
Feet together and arms downward—Sink!*

PART VIII

BOATSWAIN'S CALLS

	PAGE
THE CALL	235
PIPING AND PASSING THE WORD.....	238

BOATSWAIN'S CALLS.

NOTE.—Originally prepared by Chief Boatswain Stephen McCarthy, U. S. N., and adapted from *Naval Institute Proceedings*, No. 147.

THE CALL.

801. Description.—The instrument and its nomenclature are illustrated in Figures 1 and 2.

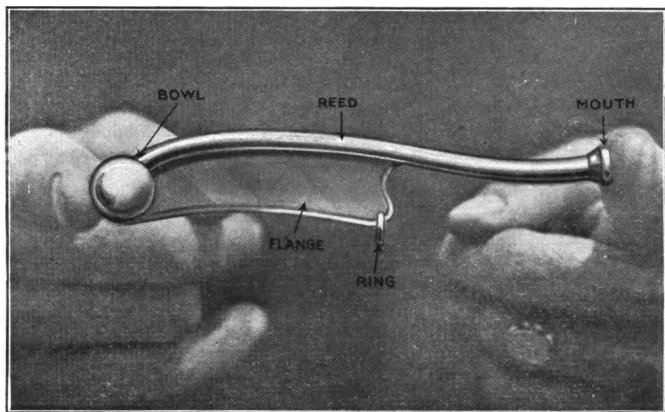


Fig. 1.

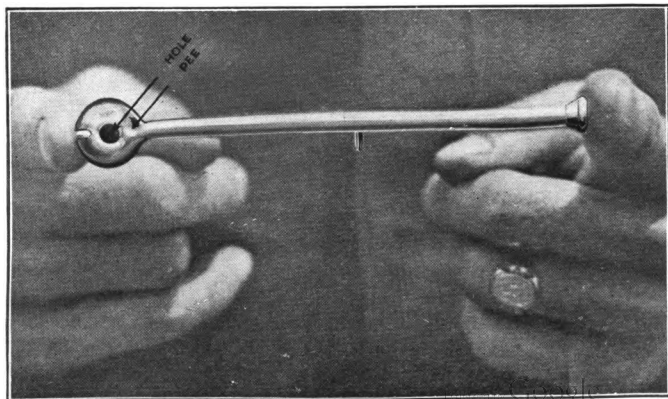


Fig. 2.

802. Tuning.—

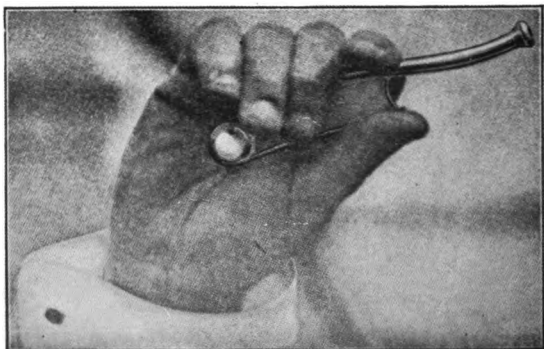
(1) Some calls issued are not shrill enough in sound, and each user of a call has his own method of tuning his call to that shrill note required in nearly all the pipes used.

(2) Most calls are too open at the pee and have to be flattened or soldered at the sides of the pee, so as to fill the space between it and the bowl.

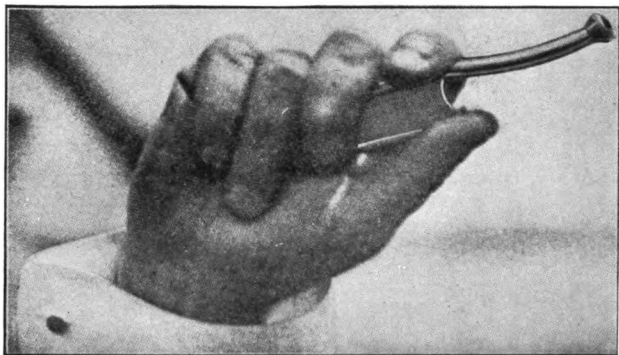
(3) Some calls are improved by scraping the wind edge or edge of the bowl furthest from the pee. It is sometimes necessary to enlarge this hole by scraping as well as by sharpening the edge until the reed strikes the hole fair. A test of this is often made by pushing the large end of a broom straw through the reed to find how the straw hits the wind edge of the hole. That edge of the hole should split the straw. The call once tuned should sound if held with its mouth to a gentle breeze; and, when blown with open hand, should sound from the most repressed pressure to the full strength of the lungs without any flaw in the sound known as wind leak, or hoarseness; and the sound with closed hand should be as clear and shrill as it is possible to make it.

803. Positions of the hand.—

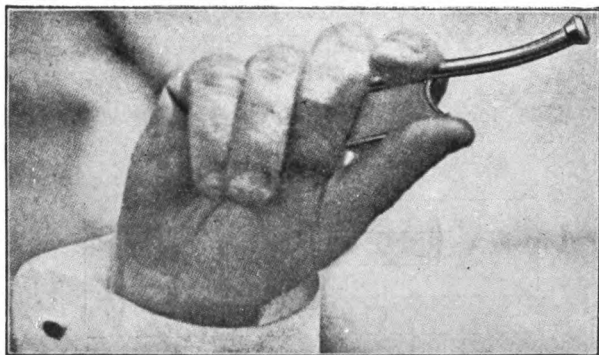
(1) There are four positions of the hand; *open*, *curved*, *closed* and *clinch*ed.



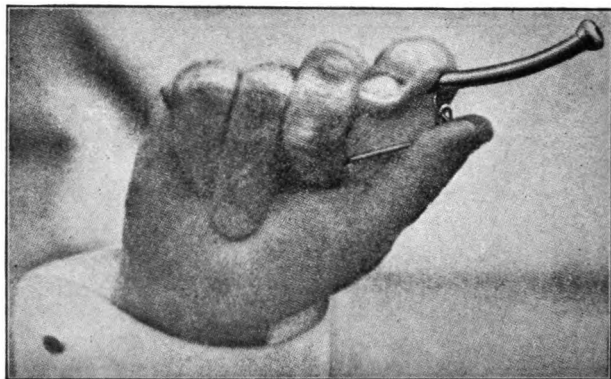
Hand Open.



Hand Curved.



Hand Closed.



Hand Clinched.

(2) These positions also indicate the lung force or pressure of blowing. As a rule the open hand calls for the least pressure required to make a soft, clear note; while the clinched calls for all the pressure that can be used in making the note shrill and clear.

PIPING AND PASSING THE WORD.

804. The score, explanation.—

(1) The four positions of the hand—open, curved, closed and clinched—are indicated on the four spaces of a musical staff, thus :

Clinched
Closed
Curved
Open

- (a) A *straight* line indicates a *smooth* note.
- (b) A *dotted* line indicates a *rattled* note.
- (c) A *broken* line indicates an *undulating* note.

(d) *Full arrow heads* along a line indicate *full* breath impulses.

(e) *Half arrow heads* along a line indicate *gentle* breath impulses.

(f) Intervals, or rests, are marked thus |, with the numeral of the seconds above, if more than one second is necessary; otherwise, notes are slurred smoothly.

(g) The number of seconds each pipe should be given under normal conditions is marked above the bar, but circumstances often call for the signal to be shortened.

(2) (a) Smooth notes are made as any ordinary whistle is blown, and are simply raised or lowered by the lung force used.

(b) Rattled notes are made by the ballarding of the tip of the tongue against the roof of the mouth, imitating a whistle rattled by a pea.

(c) Undulating notes are made by a combination of the tongue slightly undulating while the throat checks the lung pressure or flow of breath, causing the sound to undulate smoothly, but continuously, at equal intervals.

805. **The use of the voice in passing the word.**—The tone of voice in passing of the word should be modulated and pitched as the occasion calls for. The rising inflection should be given to such calls as "All hands," "Up all hammocks," etc., and the lowering inflection should be given to such calls as "Down all bags," "All the watch," etc.

806. Pipes and their uses.—

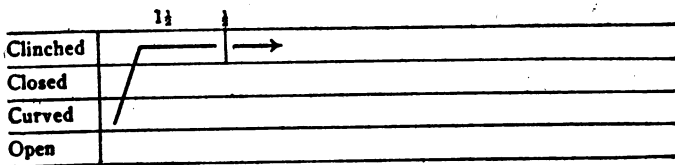
(1) *Call mates.*—Piped by the ship's boatswain to assemble his mates.

	1 1 1
Clinched	— — — — — | — — — — — →
Closed	
Curved	
Open	

(a) Call in clinched position and sound as "peep peep," "peep peep," short and shrill with a pause of less than one second after the first two peeps.

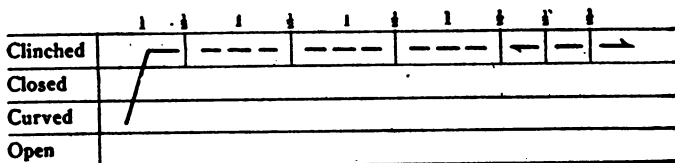
(b) This is answered by all the mates as they close on the point of assembling to receive the order to be passed from the boatswain or his chief mate, who blew the signal.

(2) *Stand by*.—Piped for "Set taut," "Stand by" and "Lay in."



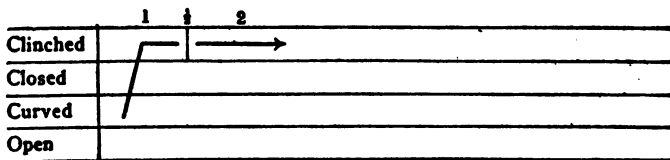
Commence with the call in the curved position and instantly change to the clinch, causing a rising peep, and follow it with a slurred peep, short and ending sharp.

(3) *Lay up*.—Piped to send men up or aloft together.



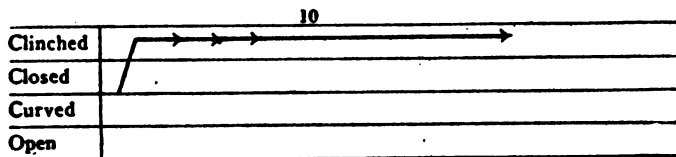
Commence as in "Stand by" and follow the long peep by a series of three sharp peeps with an interval of about one second between each series of peeps, and slow down the last three peeps to about equal intervals between them.

(4) *Lay out*.—Piped to "Lay out" in manning yards or rail; also for "Trice up" and "Out booms."



As in "Stand by," excepting that the first peep is but about half the length of the second one and is pitched higher on the start. The interval of time is about the same as the verbal order, and, in fact, should be so timed.

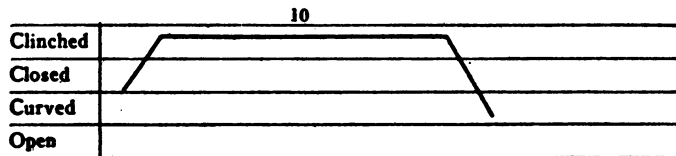
(5) *Word to be passed.*—Piped to command silence preliminary to passing an order or the word about information.



(a) Call in the closed position and clinch within a second. Impulse the shrill call with the lung force about three times and end sharp.

(b) The length of this pipe should not be less than five nor more than ten seconds. Sing out the words, "D'ye hear there," then wait for all hands to silence and pass the word as given by the officer of the deck.

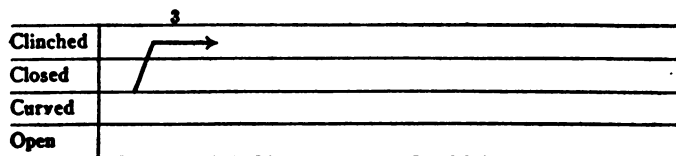
(6) *Hoist away.*—Piped in hoisting boats, in hoisting generally, and in the walk away with the cat or fish falls; and is always preceded by the pipe "Set taut."



(a) Same as No. 5, excepting that the shrill is not impulsed and the shrill is softened by changing the position from clinched to curved, and the lung pressure is lessened so as to finish low and soft, instead of sharp.

(b) The length of this pipe is about ten seconds for a signal to make a long walk away in hoisting.

(7) *Haul.*—Piped to keep men pulling together.

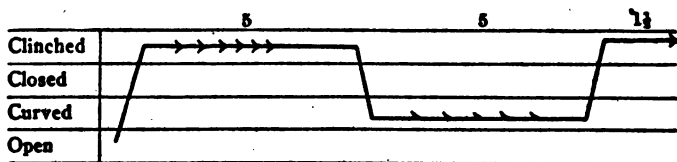


(a) Call in the closed position and change to the clinched, and so timed as to sound about an equal length of time in each

position; finish with a sharp shrill. Normal time about three seconds.

(b) This signal is used at such times as the men are facing their work at a standstill and in position for a pull together. The low note of the signal is "Stand by," and the shrill note "Pull." This is repeated as often as the signal is blown and the length of the shrill note signifies the strength and amount of rope to be gained in the pull, so that as the signal is shortened it becomes the first note of the "Short belay."

(8) *Belay*.—Piped to avast hauling and make fast; and also to annul an order just piped.



(a) Call open; close sharply to the clinch and impulse with the tongue to the roof of the mouth about six times while holding the first shrill of about five seconds; then change to the curved and impulse softly with the breath and tongue to cause a smooth, undulating sound for about the same interval as the impulsed shrill; then clinch sharply and finish with three shrill slurred peeps in rapid succession.

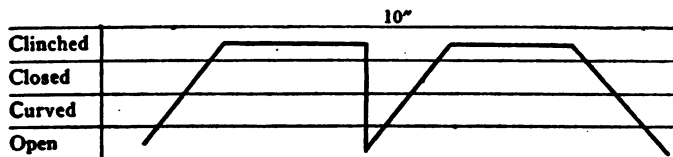
(b) This is the most difficult pipe to blow, owing to the contraction of it. The "Short belay" is more uniform in sound, as it really grows out of the "Short haul." The "Short belay" means "Hold fast."

(9) *All hands*.—Piped as a "general" for all events calling upon "all hands"; also for calling the first, mid and morning watches.



Close to the clinched and impulse softly about three times, holding the shrill for ten seconds, ending sharp, then again close to the clinched softly and hold the second shrill for ten seconds and allow it to fall softly to a finish for three seconds.

(10) *Boat call*.—Piped to call away a boat; also to call a division or divisions to quarters.



(a) Call in the open, close to the clinched, hold the shrill for five seconds, then open and close again to the clinch and hold the second shrill for another five seconds, then open and allow the signal to end softly, allowing about three seconds for the fall to silence.

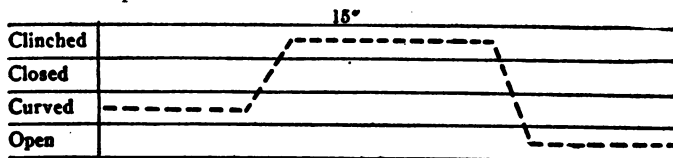
(b) All hands should listen to this pipe, as the boatswain's mate is to sing out in a long-drawn "Away" the boat that is to be manned; and he should use the word "away" a second time in the call of the barge or the gig; such as "Away, barge (or gig), Away." Etiquette requires that both the pipe and the word, when calling away the barge or the gig, should be full lengthened. The pipe and the word for other boats are not to be so long.

(c) In calling a division or divisions to quarters, follow with "All the division—to quarters."

(d) The boatswain's mate looks for silence as in after the "Word to be passed" pipe, and then pitches his voice in a roaring song, raising it to its full power on the first word of the call, and lowering it on the last syllable of the last word.

(e) The interval of the song is about equal to the interval of the call.

(11) *Heave around*.—Piped for "Mess gear"; also to heave around a capstan.

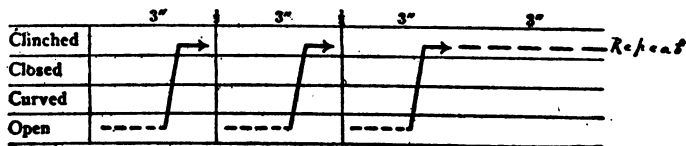


(a) Call in the curved, and blow very softly with an undulating sound by checking the breath with the throat, allowing the tongue to slowly undulate; then in the clinched position, increasing the rapidity of the undulations from about the same interval as during the rising; then allow the sound to fall back to the soft, low tones of the start.

(b) Make a double heave around for the capstan, and a single long heave around for mess gear; but the interval of the

double heave around should not exceed that of the single heave around.

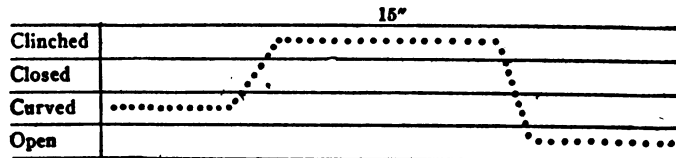
(12) *Sweepers*.—Pipes all sweepers to start their brooms and clean out spit-kits.



(a) Commence as in "Heave around" and close sharply to a short shrill. Repeat this three times and finish with four or five sharp peeps from the closed to the clinched in rapid succession. Repeat this from its commencement, but instead of finishing with the sharp peeps make the sound more like an impulsed shrill as though slurring the peeps.

(b) If necessary, the boatswain's mates follow with the word "Clear up the decks for quarters."

(13) *Veer*.—Piped to "Ease away," "Walk back" and "Slack away." A slurred veer calls side boys to "tend the side"; one veer, two side boys; two veers, four side boys; three veers, six side boys; four veers, eight side boys.

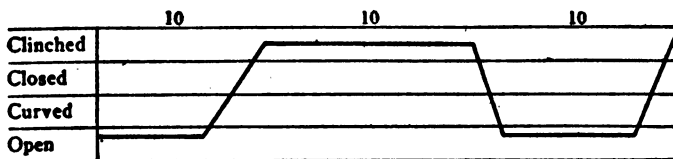


(a) Call in the curved and blow to imitate a whistle rattled by a pea. This rattling sound is produced by ballarding the tip of the tongue against the roof of the mouth; and the rapidity of the ballarding is in proportion to the pitch of the sound, rising to the maximum in the shrill rattle.

(b) For walking back the falls, this pipe is sounded continuously during the walk back or the lowering from a belay; and the speed of the lowering is in proportion to the undulations of the pipe, or the rapidity of its rising and falling in sound caused by changing from curved or open to clinched, sometimes accentuated by impulsing with the throat; short peeps of it indicate to "lower handsomely" for a short distance as in the case of fouling while lowering.

(c) At the finish of the lower or at the "come up," the signal is finished with a short, sharp peep as in the finish of "Pipe down."

(14) *Piping the side.*—Accompanies appropriate side honors.



(a) Fill the lungs, commence with the lowest smooth note and rise to the shrill, then fall to the low note again and finish with a low, soft shrill.

(b) The time in rising to the shrill should be about equal to the time of holding the shrill, and the time of falling from the shrill should be about one-third less than that of rising, so that the time of rising, holding and falling to a finish are about equal.

(c) The pipe "Alongside" is started in time to finish as the boat makes the gangway.

(d) The pipe "Over the side" is started in time to finish it when the visitor is greeted by the officer of the deck. At the first note of this pipe, the boatswain's mate takes station in rear of the proper inboard side boy and all side tenders come to the "Salute," remaining at "Salute" during the sound of the pipe, and dropping to "Attention" at its last note.

(e) Upon the visitor's departure the ceremony is reversed as follows: Boatswain's mate commences the first note of "Over the side" as the visitor passes him in departing; and the first note of "Away" as the visitor's boat gathers headway and curves away from the gangway in shoving off, and this signal should be very long-drawn in the finish.

(f) In the piping of officials alongside and over, the side pipe is lengthened to full breath for officials receiving eight side boys. But short side pipes in any event are considered lubberly and contrary to the proper "etiquette of the side."

(g) For officials received with eight or six side boys, the side will be piped by the ship's boatswain. For officials received with four side boys, the side will be piped by the chief boatswain's mate. For officials received with two side boys, the side will be piped by a boatswain's mate.

(15) *Pipe down.*—

(a) This pipe is a combination of the pipe "Word to be passed" and a long veer of about ten seconds; ending in a sharp, short peep, with an interval of one second between the two pipes.

(b) This signals the termination of all evolutions and ceremonies to which all hands had been called, and is blown by

the boatswain's mate of the watch. After the sounding of taps, follow the "Pipe down" with "Silence fore and aft."

(16) *Pipe to (any) meal.*—

(a) Pipe "All hands," long "Heave around" (mess gear) and long "Pipe down."

(b) The combined calls should cover an interval of not less than one minute.

PART IX

BUGLE CALLS

	PAGE
BUGLE CALLS IN GENERAL.....	249
BUGLE CALLS USED ON BOARD SHIP.....	260
INFANTRY AND ARTILLERY CALLS.....	275
MARCHES AND QUICKSTEPS.....	283

BUGLE CALLS.

BUGLE CALLS IN GENERAL.

901. General Remarks.—(1) The music in the following pages gives the authorized bugle calls, drill signals, and the most common marches used in the U. S. Navy.

(2) Particular attention is necessary that all buglers be required to maintain the pitch of all bugles in the key of G. The standard Navy bugle is pitched in the key of G. There is nothing so distressing as a number of the bugles of the fleet sounding off, pitched variously.

(3) The bugle calls and drill signals will conform strictly to the music as herein printed, and the various calls will be used only for the purpose indicated under the explanations and definitions. Particular attention must be given to *time*. While the employment of the bugle for any particular occasion is not mandatory, it is important that the calls always have the same signification.

(4) All buglers and trumpeters are instructed in sounding a number of marches, both quickstep and double, but it is considered sufficient to embody only a few of these in the music. These are sufficient for reference, though others may be used if desirable. In regard to the double-time, any six-eight quickstep may be used as a double-time by playing it more rapidly. (See Quicksteps Nos. 4 and 5.)

(5) Infantry and artillery calls, and certain routine and miscellaneous calls, are identical in the Army and Navy.

(6) Certain calls, which are primarily infantry or artillery calls, have been adapted to additional uses on shipboard, as indicated in the table.

(7) Most calls are sounded by one bugler or trumpeter, but such general calls as *colors* (both morning and evening), *reveille*, *tattoo*, *taps*, *general quarters*, *abandon ship*, the *assembly*, *flourishes*, and *ruffles* are sounded by all the field music simultaneously.

(8) The table below gives a list of the approved bugle calls of the U. S. Navy, together with a brief description of the use of each, and the name of the call when used in the U. S. Army. Many of the calls given herein are not used frequently on board ship, being supplanted by signals given by the pipe or by word of mouth.

902. Routine calls.—

NOTE.—The number in second column is the number of the call in the list of appended music.

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY CALL.
Reveille	1	Beaten or sounded when all hands are called in the morning. "All hands" is piped immediately after the call is finished.	Reveille.
Tattoo	2	Beaten or sounded at 9 p. m. in port as a signal for silence to be maintained about the decks. It is followed immediately by "pipe down," and about three minutes later by taps.	Tattoo.
Taps	3	Sounded about three minutes after "pipe down." It is a signal for all men to turn in for the night and maintain silence.	Taps.
First-Call	4	Sounded five minutes before morning and evening colors, and tattoo. It calls buglers to assemble, and also is a warning-signal to others who participate in the evolution, such as quartermaster, electricians, lamp lighters, etc. It may also be used as a preliminary call at other times when it is desired to assemble the buglers.	Assembly of Trumpeters.
Morning Colors..	5	The flag leaves the deck at the first note. On board ship only the first part of the call is sounded. On shore the whole call is sounded.	To the Color.
Evening Colors..	6	The flag leaves the truck or peak at the first note.....	Retreat.
Officers	7	Sounded five minutes before a formation at which officers must be present. It is also used at other times, when specially provided for, such as to call all officers to assemble at a certain designated point.	Officers' Call.
Assembly	8	Signal for divisions to assemble for muster.....	Assembly.
Drill	9	Signal to assemble for drill; or, if already assembled, to proceed with the drill or exercise.	Drill-Call.

Routine calls.—Continued.

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY CALL.
Secure	10	Signal to <i>secure</i> , used after battle drills and emergency drills.	
Recall	11	Sounded to recall men who are out of the ship for drill or for exercise, such as at boat drill, infantry or artillery on the dock, in swimming, etc.	Recall.
Dismiss (Retreat from Drill).	12	Signal to dismiss from drill. Sounded after <i>secure</i> or sounded alone after division drills.	
Sick	13	Usually sounded between 8 and 9 a. m. as a signal for men requiring medical attention to report at the sick bay.	Sick.
Band	14	To call the band to the quarter deck.	
Full Guard	15	Calls the whole guard to the quarter deck.	1st Sergeant's Call.
Sergeant's Guard.	16	First two bars of Full Guard call. Calls petty officer's guard to the quarter deck.	
Mess Gear	17	A signal to spread mess gear.	Mess.
Provisions	18	Sounded about 2 p. m. as a signal that provisions are about to be served out. Also used as a signal to equip and provide boats for abandon ship.	Issue.
Attention (or Silence).	67	When sounded for a passing vessel it is a positive command for every man in sight from outboard to stand at attention in his tracks, facing the passing vessel. If used at drill or fleet maneuvers, it is an order for every one to stand at attention and maintain silence.	Attention.
Carry On	19	Sounded after <i>silence</i> , is a signal to resume conditions existing before <i>silence</i> was sounded.	

Routine calls.—Continued.

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY CALL.
Hammocks	20	Is a signal for every man using a hammock to fall in abreast his hammock and maintain silence.	
Clean Bright Work.	21	Signal to clean assigned bright work.	
Knock off Bright Work.	22	Signal to stow away all cleaning gear.	
Water Tight Doors.	23	Signal to secure the ship below the water line for the night, during maneuvers or in fog.	
Inspection	24	Signal for captain's (executive's) weekly inspection of holds and store rooms. To be sounded also following captain's Saturday morning inspection of crew, as signal for lower deck men to lay below preparatory to captain's inspection of lower decks.	
Liberty Party...	25	Calls liberty party to form for inspection.	
Light Smoking Lamp.	26	Signals permission for the crew to smoke.	
Out Smoking Lamp.	27	Signals knock off smoking.	

903. Miscellaneous calls.—

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY CALL.
Torpedo Defense Quarters.	28	This call on board ship is the signal for <i>torpedo defense quarters</i> ; on shore it is the signal <i>to arms</i> .	To Arms.
General Quarters.	29	Signal for every man to go to his station for general quarters, and to <i>cast loose and provide</i> .	General (abbreviated).
Abandon Ship.....	30	The signal to get out and man boats for abandon ship and to shove off.	Fire.
Fire Quarters....	31	Sounded simultaneously with the ringing of ship's bell. One blast, fire forward; two blasts, aft. Usually followed by <i>assembly</i> which is a signal for men to fall in at quarters for muster when their duties are completed.	
Swimming	32	Signal to prepare for swimming, put on trunks, etc.	
Go in Water.....	33	Signal to go in the water for swimming. Sounded after boat is in position and boom lowered. Sometimes called "over-board."	
Church	34	Sounded as a signal that church is rigged, and that Divine Service is about to be held. It is followed by tolling the ship's bell.	Church.
Flourishes	35	Are sounded on the bugle as a mark of respect to officials of high rank, etc., the number in this case never in excess of four, depending on the rank of the official.	Flourishes for Review.
Ruffles	36	Are beaten on a drum, accompanying the flourishes, and in the same number in each case.	Ruffles.
Extra Duty Men.	37	Signal for extra duty men to fall in at designated position...	Fatigue.
Division	38	Calls designated division to quarters. It is half of <i>assembly</i> followed by <i>c</i> notes to indicate the division.	

SHIP AND GUN DRILLS.

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY CALL.
Man Overboard...	72	A signal that there is a man overboard.....	Charge.
School	39	On board ship, and at training stations, to call classes to their studies.	Stable-Call.
Saluting Gun Crews to Quarters.	40	Sounded as a signal to all concerned to make all necessary preparations to fire a salute.	Double Time.
Belay	41	To countermand or revoke a call just preceding it.	Dress Parade.
Bear a Hand....	71	Same as <i>double time</i> . Used to indicate haste in obeying previous call.	
General Muster...	64	All divisions assemble at "general muster".....	
Torpedo Defense Fire Control Exercise.	42	Signal for fire control exercise, torpedo defense battery. When searchlights are to be included in the exercise, to be followed by call <i>man searchlights</i> .	
Main Battery Fire Control Exercise.	43	Signal for fire control exercise, main battery; including range finders.	
Man Searchlights.	44	Followed by the number of <i>c</i> notes; it is the signal to man the searchlight or searchlights designated. Sounded without designating notes, it is the signal to man <i>all</i> searchlights.	
Man Range Finders.	45	Followed by the number of <i>c</i> notes, it is the signal to man the range finder or range finders designated. Sounded without designating notes, it is the signal to man <i>all</i> range finders.	
Surgeon's Party.	46	Calls dressing station crews and battle stretchermen to muster at the sick bay for instruction in <i>first aid</i> .	
All Signalmen...	47	Calls all the signal crew to muster on the signal bridge.	

Miscellaneous calls.—Continued.

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY CALL.
Working Party..	48	Assembles a working detail. If necessary, to be followed by the required number of <i>c</i> notes to designate the number of hands to be furnished by each part of the ship.	
Man Torpedo Defense Battery.	88	The same as <i>on right into line</i> . To be used at general quarters to call the torpedo defense gun crews <i>from</i> reserve.	
Torpedo Defense Battery in Reserve.	89	The same as <i>on left into line</i> . To be used at general quarters to send the torpedo defense battery <i>into</i> reserve.	
Commence Coal-ing.	92	Same as <i>commence firing</i> .	
Knock off Coal-ing.	93	Same as <i>cease firing</i> .	

904. Boat calls.—

NOTE.—If there be more than one boat of a kind its number is indicated by the proper number of *c* notes following the call.

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.
Steamers	49	Calls away or designates the steamer indicated by the number of <i>c</i> notes.
Launches	50	Calls away or designates the sailing launch or motor launch indicated.
Cutters	51	Calls away or designates the cutter indicated.
Whaleboats	52	Calls away or designates the whaleboat indicated.
Barge	53	Calls away or designates the barge indicated.
Gig	54	Calls away or designates the gig indicated.
Dinghy	55	Calls away or designates the dinghy indicated. Call sounded twice.
Wherry	55	Calls away or designates the wherry indicated. Call sounded once.
Away all Boats..	56	Calls away all boats either for exercise or when all boats are to be used for landing, or for an armed boat expedition.
Hook On.....	57	Signal to hook on and prepare for hoisting the boat or boats whose call precedes the <i>hook on</i> . To hook on all boats, sound "away all boats" and follow it by "hook on."
Man the Boat Falls.	58	Signal for all hands to man the boat falls which may be indicated by word of mouth or by boat call.
Running Boat Crew.	59	Calls the running boat crew detailed for the day's duty. Does not designate what boat they are to man.
Race Boat Crew.	60	Calls away the race boat.

905. Infantry and artillery calls.—(1) These calls are the same, and they are used for the same purpose, as corresponding calls in the U. S. Army. Remarks on their use on shore are given below.

(2) Aside from the drill signals, whose use is evident from their names, the following calls, not ordinarily used on board ship, are used on shore; as, for example, with the Naval Brigade or a battalion in camp or in barracks.

ARMY AND NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.
Guard-mount	61	The first or preparatory signal for guard-mounting. The second call is the assembly.
Company-Com- mander's Call.	62	Signal for company-commanders to convene at previously designated position.
Call to Quarters.	63	Used on shore in barracks or in camp as a signal for men to go to their quarters or tents. It is usually sounded about five minutes before taps, depending on regulations. In such cases tattoo will usually be sounded one-half hour before taps.
Dress-Parade ...	64	Warning signal for companies to form for dress-parade. The signal for the companies to fall in is the assembly. Used on board ship; it is the call for all divisions to assemble at "general muster."
General	65	Signal for striking tents and loading wagons preparatory to marching.
Adjutant's-Call .	66	Signal for companies to form battalion. Immediately after this call the adjutant posts the guides of color-company and that company marches on line. Used also on board ship to form battalion.

906. Remarks on the use of bugle calls on shore.—In the following remarks the Army names of the various calls are used. The call is indicated by the number abreast each, which refers to the number of the call in the music which is appended.

(1) **WARNING CALLS.**—(a) *First-call* (4), *Guard-mount* (61), *Dress-parade* (64), and *Drill* (9) precede the *Assembly* (8) by such interval as may be prescribed by the commanding officer.

(b) *Mess* (17), *Church* (34), and *Fatigue* (37), classed as service calls, may also be used as warning calls.

(c) *First-call* (4) is the first signal for formation for roll-call and for all ceremonies except guard-mounting.

(d) *Guard-mount* (61) is the first signal for guard-mounting.

(e) The field music assembles at *First-call* and *Guard-mount*.

(2) FORMATION CALLS.—(a) *Assembly* (8): the signal for companies or details to fall in.

(b) *Adjutant's call* (66): the signal for companies to form battalion, also for the guard details to form for guard-mounting on the camp or garrison parade ground; it follows the assembly at such interval as may be prescribed by the commanding officer.

(c) *To the color* (5) is sounded when the color salutes; it is also used as the signal for the battalion to form brigade.

(3) ALARM CALLS.—(a) *Fire-call* (31): the signal for the men to fall in, without arms, to extinguish fire.

(b) *To arms* (28): the signal for the men to fall in, under arms, on their company parade grounds as quickly as possible.

(4) SERVICE CALLS.—(a) *Tattoo* (2), *Taps* (3), *Mess* (17), *Sick* (13), *Church* (34), *Recall* (11), *Officers* (7), *Company-commanders* (62), *i. p. o.'s* (15), *Fatigue* (37), *School* (39), and the *General* (65).

(b) *Reveille* (1) precedes the *Assembly* (8) for roll-call; *Retreat* (6) follows the *Assembly*, the interval between being only that required for formation and roll-call, except when there is parade.

(c) *Taps* (3) is the signal for extinguishing lights; it is usually preceded by *Call to quarters* (63) by such interval as prescribed by Regulations.

(d) *Assembly*, *Reveille*, *Retreat*, *Adjutant's Call*, *To the color*, *The flourishes*, *Ruffles*, and the *Marches* are sounded by all the field music united; the other calls, as a rule, are sounded by the musician of the guard or orderly musician; he may also sound the assembly when the musicians are not united.

(e) *The morning gun* is fired at the first note of *Reveille*. or if marches be played before reveille, it is fired at the commencement of the first march.

(f) *The evening gun* is fired at the last note of *Retreat*.

907. Drill signals.—(See Calls 67 to 105.)

(1) The drill signals include both the preparatory commands and the commands of execution; the last note is the command of execution.

(2) When a command is given by the bugle, the chiefs of subdivisions give the proper commands orally.

(3) The memorizing of these signals is facilitated by observing that all signals for movements to the *Right* are on the *ascending scale*, that the signals for the same movements to the *Left* are corresponding signals on the *descending scale*; that

changes of gait are all on the same note; that *c. c.'s call* is the first two bars of *Officer's call* with the *Attention* added.

(4) The various calls are given in the music. The meaning of each is apparent from its name. 76 and 77 are preparatory signals to indicate simultaneous movements by companies or battalions.

908. Marches and quicksteps.—

NAVY CALL.	NUMBER OF CALL.	EXPLANATION OF USE.
President's March.	106	Played when President visits a ship-of-war.
C.-in-C.'s March.	107	Played when a flag officer comes on board officially. Same as the Army General's March.
Rogue's March...	108	Played when a thief or other man is expelled from camp in disgrace.
Funeral March...	109	Played at funerals.
Quickstep No. 1..	110	Played as a march.
Quickstep No. 2..	111	Played as a march.
Quickstep No. 3..	112	Played as a march.
Quickstep No. 4..	113	Played as a march; also as a double.
Quickstep No. 5..	114	This is an ordinary 6/8 quickstep but is generally used as a double by playing it more rapidly.
Quickstep No. 6..	115	March. Also a double.
Quickstep No. 7..	116	March (Army).
Quickstep No. 8..	117	March (Army).
Quickstep No. 9..	118	March (Sousa).

BUGLE CALLS USED ON BOARD SHIP.

909. Routine calls.—

1. Reveille.



2. Tattoo.



Tattoo.—Continued.

Tattoo.—Continued.

3. *Taps.*4. *First-Call.*5. *Morning Colors.*

FINE.

D. C.

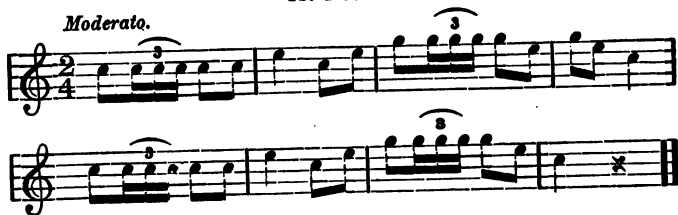
6. Evening Colors.

Moderato.

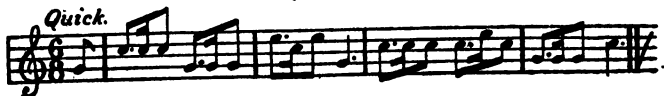
A musical score for a piece titled "6. Evening Colors." The tempo is marked "Moderato." The score is written for three staves, each with a treble clef and a 2/4 time signature. The music consists of a series of eighth and sixteenth notes, with some measures containing rests or specific rhythmic patterns. The score is divided into four systems, each containing three staves. The first system has three staves. The second system has three staves. The third system has three staves. The fourth system has three staves. The music ends with a double bar line and a repeat sign.

7. *Officers.**Quick.*8. *Assembly.**Moderato.*9. *Drill.**Quick.*10. *Secure.*

11. Recall.

Moderato.

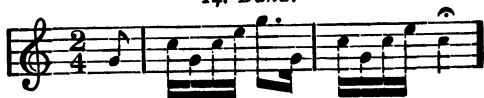
12. Dismiss (Retreat from Drill).

Quick.

13. Sick.

Quick.

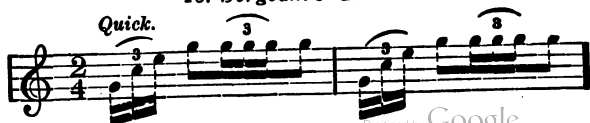
14. Band.



15. Full Guard.

Quick.

16. Sergeant's Guard.

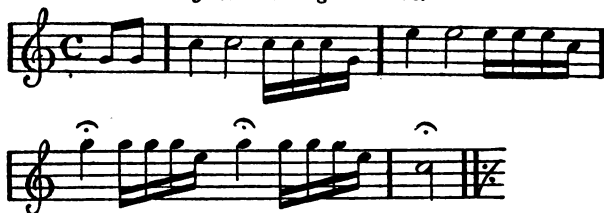
Quick.

17. *Mess Gear.**Quick.*18. *Provisions.**Allegro.*19. *Carry On.*20. *Hammocks.**Quick.*21. *Clean Bright Work.**Quick.*

22. Knock Off Bright Work.

Moderato.

23. Water Tight Doors.



24. Inspection.

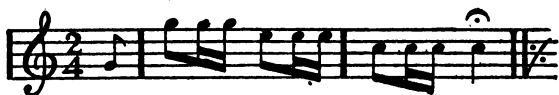


25. Liberty Party.

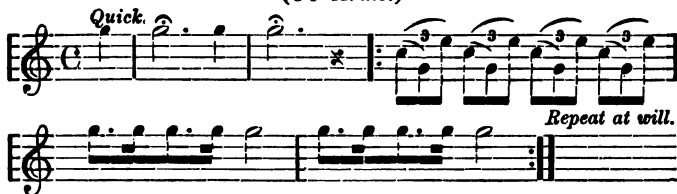


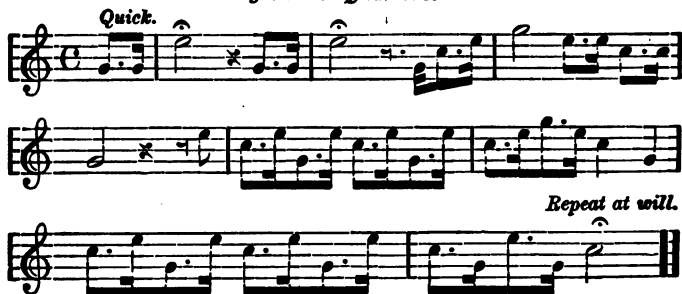
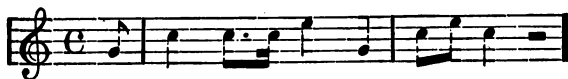
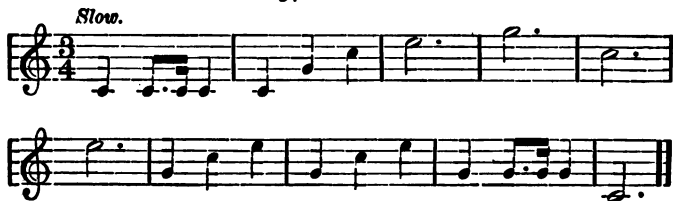
26. Light Smoking Lamp.



27. *Out Smoking Lamp.*

910. Miscellaneous calls.—

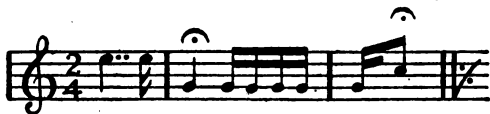
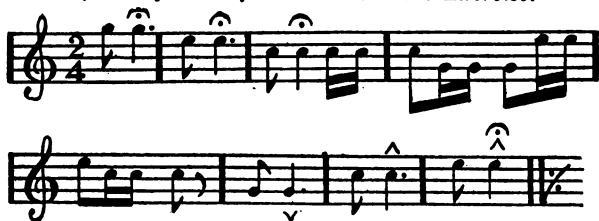
28. *Torpedo Defense Quarters.*
(To Arms.)29. *General Quarters.*30. *Abandon Ship.*

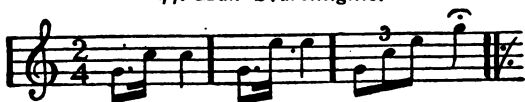
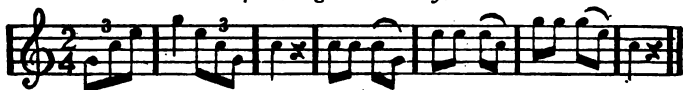
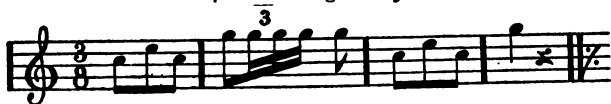
31. *Fire Quarters.*32. *Swimming.*33. *Go in the Water (Overboard).*34. *Church.*35. *Flourishes.*

36. *Ruffles (for the Drum).*37. *Extra Duty Men.*

40. *Saluting Gun Crews to Quarters.*41. *Belay (to Revoke a Call).*

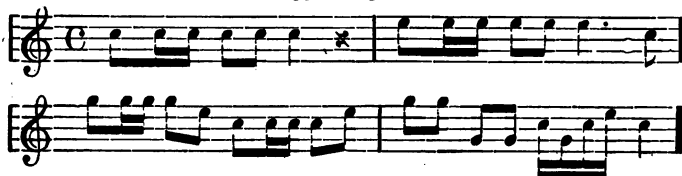
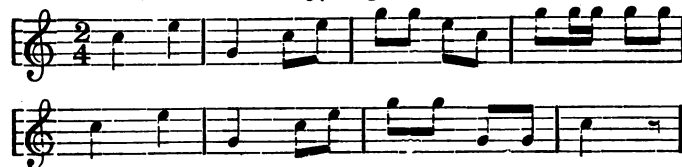
NOTE.—Repeat the call, if necessary, and then sound *belay*.

42. *Torpedo Defense Fire Control Exercise.*43. *Main Battery Fire Control Exercise.*

44. *Man Searchlights.*45. *Man Range Finders.*46. *Surgeon's Party.*47. *All Signalmen.*48. *Working Party.*911. *Boat calls.—*

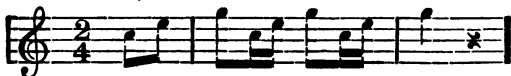
NOTE.—If there be more than one boat of a kind its number is indicated by the proper number of *c* notes following the call.

49. *Steamers.*50. *Launches.*

51. *Cutters.*52. *Whaleboats.*53. *Barge.*54. *Gig.*55. *Dinghy (or Wherry).*

NOTE.—To call away dinghy, sound this call twice. To call away wherry, sound this call once.

56. *Away All Boats.*

57. *Hook On.*58. *Man the Boat Falls.*59. *Running Boat Crew.*60. *Race Boat Crew.*

INFANTRY AND ARTILLERY CALLS.

912. Calls used mainly on shore.—

61. *Guard-mount.*

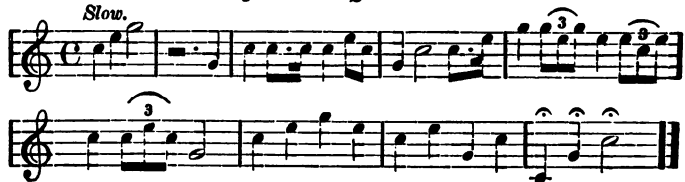
62. Company Commander's Call.

Quick.



63. *Call to Quarters.*

Slow.



64. *Dress-Parade.*
(Ship call—General Muster.)

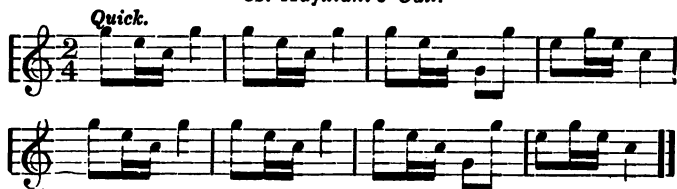
Quick.



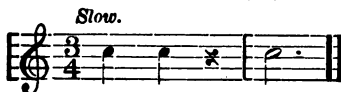
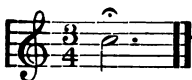
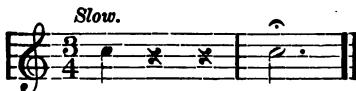
65. General.

Quick.



66. *Adjutant's Call.*

913. Drill signals.—

67. *Attention (or Silence).*68. *Forward; or, Full Step. MARCH.*
(Or *Man the Drags.*)69. *Halt.*70. *Quick Time. MARCH.*71. *Double Time. MARCH.*
(*Ship call—Bear a Hand.*)

72. Charge.

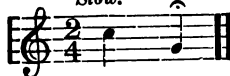
(Ship call—Man Overboard.)

Quick.

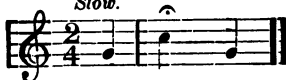
73. Guide Right.

Slow.

74. Guide Left.

Slow.

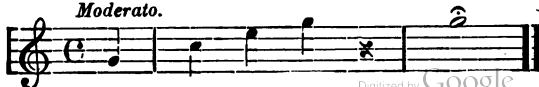
75. Guide Center.

Slow.

76. Companies.

Quick.

77. Battalions.

Moderato.78. Squads Right; or, By the Right Flank.
(In Artillery, Sections Right Turn.) MARCH.*Moderato.*

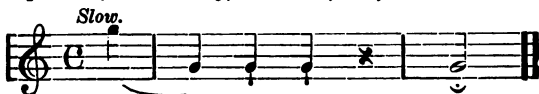
79. *Squads Left; or, By the Left Flank.*
(In Artillery, Sections Left Turn.) MARCH.



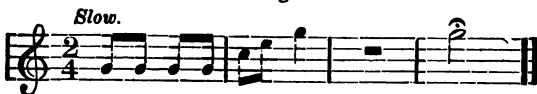
80. *Squads (In Artillery, Sections) Right About.* MARCH.



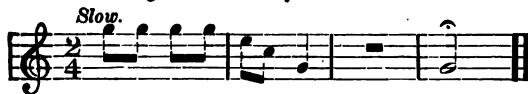
81. *Squads (In Artillery, Sections) Left About.* MARCH.



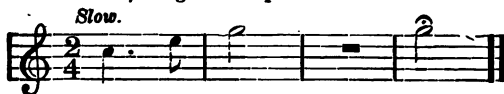
82. *Column Right.* MARCH.



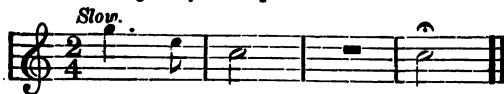
83. *Column Left.* MARCH.

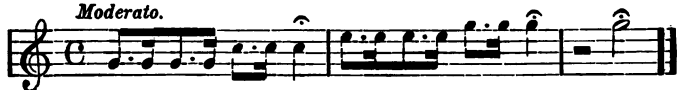


84. *Right Oblique.* MARCH.



85. *Left Oblique.* MARCH.

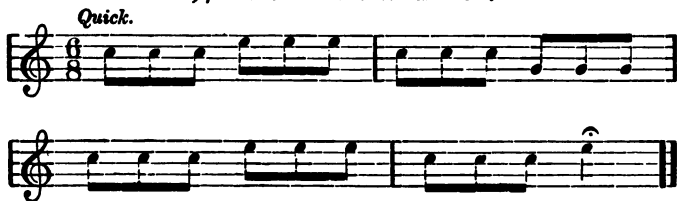


86. *Right Front into Line. MARCH.**Moderato.*87. *Left Front into Line. MARCH.**Moderato.*88. *On Right into Line. MARCH.*
(Ship call—Man Torpedo Defense Battery.)*Moderato.*89. *On Left into Line. MARCH.*
(Ship call—Torpedo Defense Battery in Reserve.)*Moderato.*90. *Company (or Companies) Right. MARCH.*
(In Artillery, Platoons Right Turn.)*Moderato.*91. *Company (or Companies) Left. MARCH.*
(In Artillery, Platoons Left Turn.)*Moderato.*92. *Commence Firing.*
(Also Commence Coaling.)*Quick.*

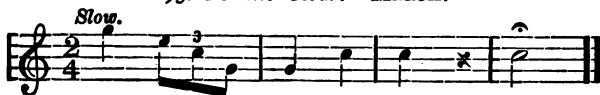
93. *Cease Firing.*
(Also Knock Off Coaling.)



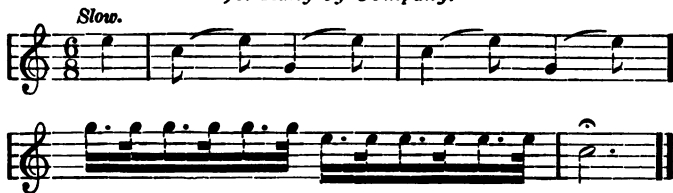
94. *As Skirmishers.* MARCH.



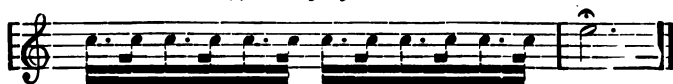
95. *To the Rear.* MARCH.



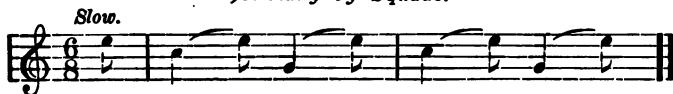
96. *Rally by Company.*



97. *Rally by Sections.*

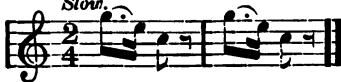
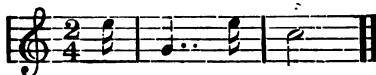


98. *Rally by Squads.*



99. *Face to the Rear.**Slow.*100. *In Battery.**Moderato.*101. *From the Right, Front into Echelon.**Moderato.*102. *From the Left, Front into Echelon.*

NOTE.—From the right (or left) rear into echelon are the same calls as 101 and 102, respectively, followed by FACE TO THE REAR (99).

Moderato.103. *Lie Down.**Slow.*104. *Rise.**Slow.*105. *Route Step. MARCH.*

MARCHES AND QUICKSTEPS.

914. Marches.—

106. *President's March.**Quick time.*107. *Commander-in-Chief's March.**Quick time.*

*Quick time.*108. *Rogue's March.**Very slow.*109. *Funeral March.*

Musical score for 'Funeral March' in 2/4 time. It consists of six staves. The first three staves are marked with a forte 'f' dynamic. The last three staves are marked with a piano 'p' dynamic. The score includes various musical notations such as rests, notes, and repeat signs. The instruction 'Repeat at will.' appears at the end of the piece.

915. Quicksteps.—

110. Quickstep No. 1.

Quick.

111. Quickstep No. 2.



114. *Quickstep No. 5.*

NOTE.—Used chiefly as a double, but may also be used as a quickstep.

115. *Quickstep No. 6.*

116. Quickstep No. 7.



117. Quickstep No. 8.



118. Quickstep No. 9.



